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EPA METHOD STUDY 20,
METHOD 610--PNA's

by

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16. ABSTRACT

Sixteen laboratories participated in an interlaboratory study conducted to provide precision and accuracy statements for the proposed EPA Method 610 for 16 selected polynuclear aromatic hydrocarbons(PNA's) which may be present in municipal and industrial aqueous discharges. Method 610 involves extraction of the pollutants with methylene chloride and subsequent analysis of the subject compounds by high performance liquid chromatography utilizing fluorescence and ultraviolet detection of the PNA's.

The study design was based on Youden's plan for collaborative tests of analytical methods. Three Youden pair samples of the test compounds were spiked into six types of test waters and then analyzed. The resulting data were statistically analyzed using the computer program entitled "Interlaboratory Method Validation Study" (IMVS). Mean recoveries of the PNA's were in the range of 41-100 percent. Overall precision was in the range of 23-91 percent and single-analyst precision was in the range of 11-48 percent.

A statistically significant effect due to water type was established for six of the sixteen PNA compounds for which recoveries from distilled water were generally lower than from wastewaters. The effect was judged to be due to the analytical learning process and, therefore, of no practical importance. For the other 10 PNA's, there were no differences of practical significance due to water types among mean recoveries, overall precisions, or single-analyst precisions.

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FOREWORD

Environmental measurements are required to determine the quality of ambient waters and the character of waste effluents. The Environmental Monitoring and Support Laboratory (EMSL)-Cincinnati conducts research to:

- Develop and evaluate techniques to measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid waste.
- Investigate methods for the concentration, recovery, and identification of viruses, bacteria, and other microorganisms in water.
- Determine the responses of aquatic organisms to water quality.
- Support an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring waste and wastewater.

This publication reports the results of EPA's interlaboratory method study for the following priority pollutants:

Naphthalene (91-10-3)*
Acenaphthylene (203-96-8)
Acenaphthene (83-32-9)
Fluorene (86-73-7)
Phenanthrene (85-01-8)
Anthracene (120-12-7)
Fluoranthene (146-44-0)
Pyrene (129-00-0)
Benzo(a)anthracene (56-55-3)
Chrysene (218-01-9)
Benzo(b)fluoranthene (205-99-2)
Benzo(k)fluoranthene (207-08-9)
Benzo(a)pyrene (50-32-8)
Dibenzo(a,h)anthracene (53-70-3)
Benzo(g,h,i)perylene (191-24-2)
Indeno(1,2,3-cd)pyrene (193-39-5)

Federal agencies, states, municipalities, universities, private laboratories, and industry should find this evaluative study of assistance in monitoring and controlling pollution in the environment.

Robert L. Booth
Acting Director, EMSL-Cincinnati

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*CAS Registry Number

ABSTRACT

The U.S. Environmental Protection Agency (USEPA) sponsored an interlaboratory study conducted to provide precision and accuracy statements for the proposed USEPA Method 610 for the 16 selected polynuclear aromatic hydrocarbons (PNA's) comprising Category 9 of the priority pollutants which may be present in municipal and industrial aqueous discharges. Method 610 involves extraction of the pollutants with methylene chloride followed by silica gel cleanup and subsequent analysis by high performance liquid chromatography (HPLC) utilizing fluorescence and ultraviolet detection (UV).

The study design was based on Youden's plan for collaborative tests of analytical methods. Three Youden pair ampules of the test compounds were spiked into six types of test waters and analyzed. The test waters were distilled water, tap water, a surface water, and three different industrial wastewater effluents. The resulting data were analyzed statistically using the USEPA computer program entitled "Interlaboratory Method Validation Study" (IMVS). Mean recoveries of the PNA's based upon inserting specific analyte concentrations into the regression equations ranged from 43-110 percent. Overall precision ranged from 16-91 percent and single-analyst precision ranged from 11-50 percent.

The study was conducted at the request of the Environmental Protection Agency, Quality Assurance Branch, EMSL - Cincinnati, Ohio under EPA Contract No. 68-03-2624. This report covers a period from September 13, 1978 to October 31, 1983, and work was completed as of December 31, 1982.

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Gratitude is also expressed to various industries for their interest in the study and willingness to provide samples of appropriate wastewater effluents without which the program's objectives could not have been realized. Lastly, we thank Mr. Edward L. Berg and Mr. Robert Graves, USEPA Project Officers, whose guidance and intense interest in the study contributed to the successful completion of a difficult and sometimes frustrating task.

SECTION 1

INTRODUCTION

USEPA first promulgated guidelines (1) establishing test procedures for the analysis of pollutants in 1973, following the passage of the Federal Water Pollution Control Act in 1972 by Congress. Pursuant to the amendment and publication of these guidelines, USEPA entered into a Settlement Agreement--the Consent Decree--which required the study and, if necessary, regulation of 65 "priority" pollutants and classes of pollutants of known or suspected toxicity to the biota. Subsequently, Congress passed the Clean Water Act of 1977(2), mandating the control of toxic pollutants discharged into ambient waters by industry.

In order to facilitate the implementation of the Clean Water Act, USEPA selected 129 specific toxic pollutants, 113 organic and 16 inorganic, for initial study. The organic pollutants were divided into 12 categories based on their chemical structure. Analytical methods were developed by USEPA for these 12 categories through in-house and contracted research. These analytical methods are currently under review by USEPA and may eventually be required for the monitoring of the 113 toxic pollutants in industrial waste water effluents, as specified by the Clean Water Act of 1977. Upon completion of the review, USEPA will promulgate a final rule.

This report describes the interlaboratory study of Method 610 proposed for the Category 9 chemicals listed below:

Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Dibenzo(a,h)anthracene
Benzo(g,h,i)perylene
Indeno(1,2,3-cd)pyrene

The primary objective of the study was to characterize the behavior of Method 610 in terms of 1) accuracy; 2) overall precision; 3) single-analyst precision; and 4) effect of water type on accuracy and precision. The study was conducted with the cooperation of 16* participating laboratories under the auspices of the EMSL-Cincinnati.

Each of the laboratories was supplied with six samples of the Category 9 chemicals as solutions in acetone packaged in flame-sealed glass ampules. One-mL aliquots of the solutions were added to six types of test waters according to instructions. Water samples were then analyzed with and without the increment, and the added level of pollutant determined by the difference. Concentrations were reported in µg/L with only one value reported for each sample.

The data were collected from the 16 laboratories according to Youden's(3) collaborative testing design. Formal statistical techniques compatible with the Youden design were used to identify outliers, estimate the method's accuracy and precision, and test for the effect of water type. The formal statistical analyses were carried out using the USEPA's IMVS computer program(4). The information obtained from the statistical analyses was summarized and reduced to a descriptive form for interpretation and presentation.

Method 610 was developed in the Battelle-Columbus Laboratories (BCL) under a contract with the Physical and Chemical Methods Branch, Environmental Monitoring and Support Laboratory-Cincinnati. Method 610 is presented in Appendix A. Briefly, the method requires extraction of the pollutants from the aqueous sample using methylene chloride. The extract is then subjected to silica gel chromatographic cleanup. The PNA fraction is concentrated using Kuderna Danish (K-D) evaporation, exchanged to acetonitrile and analyzed by HPLC with UV and fluorescence detection.

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* Three additional laboratories which participated in the study did not follow the approved analytical procedure (Method 610) and their results were not used in the statistical evaluation of the data.

SECTION 2

SUMMARY

The interlaboratory study of an analytical method such as Method 610, involves characterizing the accuracy and precision of the method over a wide range of working conditions. Accuracy is directly related to mean recovery and precision is related to both the overall variation and the single-analyst variation of the method.

A range of typical working conditions was introduced into the study by varying both the concentration levels of the analytes spiked into the sample test water and by changing the type of test water. For each analyte, three concentration levels (low, medium, and high) were used with each of six different test waters (distilled water, tap water, surface water, and three industrial wastewater effluents).

To summarize the accuracy of Method 610, the following equation was determined for each effluent:

$$X = a + b \cdot C$$

where X denotes the mean recovery and C the concentration level of the analyte. The precision was summarized for each effluent by the equations

$$S = d + e \cdot X \text{ and } SR = f + g \cdot X$$

where S denotes the overall standard deviation and SR the single-analyst standard deviation.

The data reported by the 16 participating laboratories were used to estimate the coefficients a, b, d, e, f, and g for these equations for each effluent. These equations were calculated for each effluent used in this study, and the results are summarized in Table 1.

In addition to summarizing the accuracy and precision of Method 610, the following observations were made based on the data:

- The method has a pronounced negative bias for most compounds.

- Twenty percent of the total data for all sixteen PNA's were rejected by the outlier test.

- The percentage recovery of the sixteen PNA's for a specific analyte concentration in a water type ranged from 43-110 percent. The recoveries were significantly lower than those reported by Battelle Columbus Laboratories and obtained during the development of the method.

- The overall and single-analyst percent relative standard deviations ranged from 16-91 percent and 11-50 percent, respectively, (see Tables 21 and 22).

- A statistically significant effect due to water type was established for 6 of the 16 PNA's. However, because distilled water had consistently lower recoveries than the wastewaters, and the distilled waters were the first samples to be analyzed, the statistical effect was judged to be due to the analytical learning process and, therefore, of no practical importance.

TABLE 1. REGRESSION EQUATIONS FOR ACCURACY AND PRECISION OF METHOD 610 BY COMPOUND AND WATER TYPE

WATER TYPE	NAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE
APPLICABLE CONC. RANGE	(10.00 - 375.00)	(10.00 - 425.00)	(10.00 - 260.00)	(10.00 - 463.00)
DISTILLED WATER				
SINGLE-ANALYST PRECISION	SR = 0.39X - 0.18	SR = 0.36X + 0.29	SR = 0.39X + 0.76	SR = 0.44X - 1.12
OVERALL PRECISION	S = 0.41X + 0.74	S = 0.42X + 0.52	S = 0.53X + 1.32	S = 0.63X - 0.65
ACCURACY	X = 0.57C - 0.70	X = 0.69C - 1.89	X = 0.52C + 0.54	X = 0.56C - 0.52
TAP WATER				
SINGLE-ANALYST PRECISION	SR = 0.36X + 0.24	SR = 0.38X - 0.01	SR = 0.29X + 0.27	SR = 0.25X + 1.16
OVERALL PRECISION	S = 0.39X + 0.73	S = 0.44X - 0.03	S = 0.47X + 0.45	S = 0.50X - 0.16
ACCURACY	X = 0.60C - 0.62	X = 0.71C - 2.58	X = 0.51C - 1.55	X = 0.59C - 1.30
SURFACE WATER				
SINGLE-ANALYST PRECISION	SR = 0.24X + 1.94	SR = 0.27X + 0.30	SR = 0.17X + 1.48	SR = 0.40X - 0.93
OVERALL PRECISION	S = 0.41X + 1.07	S = 0.30X + 0.08	S = 0.48X + 0.23	S = 0.52X - 0.74
ACCURACY	X = 0.60C - 0.82	X = 0.74C - 2.07	X = 0.53C - 0.59	X = 0.57C - 0.25
WASTEWATER (C-94)				
SINGLE-ANALYST PRECISION	SR = 0.19X + 1.34	SR = 0.19X + 1.02	SR = 0.35X - 0.79	SR = 0.25X + 1.60
OVERALL PRECISION	S = 0.36X + 0.26	S = 0.32X - 0.01	S = 0.50X - 0.21	S = 0.52X - 1.26
ACCURACY	X = 0.62C + 0.72	X = 0.83C - 1.16	X = 0.59C - 0.46	X = 0.60C - 0.03
WASTEWATER (C-95)				
SINGLE-ANALYST PRECISION	SR = 0.23X - 0.48	SR = 0.32X - 0.81	SR = 0.24X + 0.33	SR = 0.21X + 2.56
OVERALL PRECISION	S = 0.32X - 1.09	S = 0.36X - 0.13	S = 0.47X + 0.08	S = 0.47X - 0.44
ACCURACY	X = 0.58C + 1.04	X = 0.75C - 0.80	X = 0.57C + 0.30	X = 0.53C + 0.73
WASTEWATER (C-96)				
SINGLE-ANALYST PRECISION	SR = 0.31X + 0.26	SR = 0.17X + 0.57	SR = 0.28X + 0.34	SR = 0.35X + 0.10
OVERALL PRECISION	S = 0.41X - 0.15	S = 0.23X + 1.09	S = 0.43X - 0.54	S = 0.49X - 0.39
ACCURACY	X = 0.65C - 0.76	X = 0.83C - 1.89	X = 0.62C + 0.12	X = 0.54C + 0.36

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1. (Continued)

WATER TYPE	PHENANTHRENE	ANTHRACENE	FLUORANTHENE	PYRENE
APPLICABLE CONC. RANGE	(5.00 - 280.00)	(10.00 - 400.00)	(0.30 - 15.00)	(2.00 - 90.00)
DISTILLED WATER				
SINGLE-ANALYST PRECISION	SR = 0.28X + 0.05	SR = 0.23X + 1.16	SR = 0.22X + 0.06	SR = 0.25X + 0.14
OVERALL PRECISION	S = 0.47X - 0.25	S = 0.41X + 0.45	S = 0.32X + 0.03	S = 0.42X - 0.00
ACCURACY	X = 0.72C - 0.95	X = 0.63C - 1.26	X = 0.68C + 0.07	X = 0.69C - 0.12
TAP WATER				
SINGLE-ANALYST PRECISION	SR = 0.26X + 0.10	SR = 0.22X + 0.61	SR = 0.23X + 0.01	SR = 0.25X + 0.02
OVERALL PRECISION	S = 0.35X - 0.13	S = 0.41X + 0.10	S = 0.32X + 0.01	S = 0.39X + 0.09
ACCURACY	X = 0.71C - 0.71	X = 0.63C - 2.05	X = 0.71C - 0.03	X = 0.68C + 0.09
SURFACE WATER				
SINGLE-ANALYST PRECISION	SR = 0.23X - 0.34	SR = 0.19X + 0.22	SR = 0.27X - 0.04	SR = 0.22X - 0.10
OVERALL PRECISION	S = 0.37X - 0.62	S = 0.34X - 0.69	S = 0.44X - 0.01	S = 0.30X - 0.12
ACCURACY	X = 0.70C - 0.26	X = 0.64C - 0.45	X = 0.59C + 0.05	X = 0.74C - 0.08
WASTEWATER (C-94)				
SINGLE-ANALYST PRECISION	SR = 0.11X + 0.47	SR = 0.19X + 0.99	SR = 0.12X + 0.03	SR = 0.17X + 0.15
OVERALL PRECISION	S = 0.26X - 0.22	S = 0.39X - 0.41	S = 0.35X - 0.01	S = 0.26X - 0.02
ACCURACY	X = 0.79C - 0.61	X = 0.69C - 0.26	X = 0.75C - 0.00	X = 0.71C + 0.02
WASTEWATER (C-95)				
SINGLE-ANALYST PRECISION	SR = 0.15X - 0.03	SR = 0.19X + 0.10	SR = 0.17X - 0.01	SR = 0.27X - 0.04
OVERALL PRECISION	S = 0.28X - 0.03	S = 0.33X - 0.31	S = 0.29X + 0.02	S = 0.34X - 0.19
ACCURACY	X = 0.73C - 0.48	X = 0.64C - 0.34	X = 0.70C + 0.02	X = 0.66C + 0.25
WASTEWATER (C-96)				
SINGLE-ANALYST PRECISION	SR = 0.35X - 0.50	SR = 0.24X - 0.29	SR = 0.40X - 0.06	SR = 0.20X - 0.00
OVERALL PRECISION	S = 0.38X - 0.28	S = 0.35X - 0.91	S = 0.38X + 0.03	S = 0.25X + 0.14
ACCURACY	X = 0.70C - 0.47	X = 0.66C + 0.08	X = 0.75C + 0.01	X = 0.77C + 0.01

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1. (Continued)

WATER TYPE	BENZO(A)ANTHRACENE	CHRYSENE	BENZO(B)FLUORANTHENE	BENZO(K)FLUORANTHENE
APPLICABLE CONC. RANGE	(0.50 - 16.00)	(2.00 - 60.00)	(0.20 - 11.00)	(0.12 - 6.00)
DISTILLED WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.28X + 0.04 S = 0.34X + 0.02 X = 0.73C + 0.05	SR = 0.32X - 0.18 S = 0.56X - 0.22 X = 0.77C - 0.18	SR = 0.21X + 0.01 S = 0.38X - 0.00 X = 0.78C + 0.01	SR = 0.44X - 0.01 S = 0.69X + 0.01 X = 0.59C + 0.00
TAP WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.23X + 0.13 S = 0.37X + 0.05 X = 0.77C + 0.05	SR = 0.40X - 0.37 S = 0.55X - 0.10 X = 0.82C - 0.09	SR = 0.24X - 0.00 S = 0.32X - 0.01 X = 0.83C + 0.00	SR = 0.48X + 0.06 S = 0.91X - 0.01 X = 0.98C - 0.03
SURFACE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.18X - 0.01 S = 0.34X - 0.05 X = 0.76C - 0.02	SR = 0.39X - 0.51 S = 0.50X - 0.20 X = 0.77C + 0.39	SR = 0.26X - 0.01 S = 0.48X - 0.03 X = 0.73C + 0.01	SR = 0.19X + 0.16 S = 0.76X + 0.01 X = 1.02C + 0.04
WASTEWATER (C-94) SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.24X + 0.03 S = 0.32X + 0.06 X = 0.73C + 0.12	SR = 0.29X - 0.06 S = 0.44X - 0.09 X = 0.97C - 0.28	SR = 0.21X - 0.00 S = 0.39X - 0.02 X = 0.80C - 0.01	SR = 0.18X - 0.01 S = 0.47X + 0.01 X = 0.61C + 0.03
WASTEWATER (C-95) SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.28X - 0.04 S = 0.43X - 0.04 X = 0.69C + 0.03	SR = 0.25X + 0.42 S = 0.48X + 0.10 X = 1.22C - 0.56	SR = 0.28X - 0.01 S = 0.42X - 0.02 X = 0.90C - 0.00	SR = 0.46X - 0.07 S = 0.68X - 0.01 X = 1.09C + 0.03
WASTEWATER (C-96) SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.18X + 0.00 S = 0.32X + 0.04 X = 0.76C + 0.00	SR = 0.24X + 0.02 S = 0.45X + 0.14 X = 1.01C - 0.07	SR = 0.26X - 0.01 S = 0.37X - 0.01 X = 0.90C + 0.00	SR = 0.22X - 0.00 S = 0.69X - 0.03 X = 0.99C - 0.05

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1. (Continued)

WATER TYPE	BENZO(A)PYRENE	DIBENZO(A,H)ANTHRACENE	BENZO(G,H,I)PERYLENE	INDENO(1,2,3-CD)PYRENE
APPLICABLE CONC. RANGE	(0.20 - 15.00)	(0.50 - 24.00)	(1.00 - 50.00)	(0.75 - 22.00)
DISTILLED WATER				
SINGLE-ANALYST PRECISION	SR = 0.38X - 0.01	SR = 0.24X + 0.02	SR = 0.25X + 0.04	SR = 0.29X + 0.02
OVERALL PRECISION	S = 0.53X - 0.01	S = 0.45X + 0.03	S = 0.58X + 0.10	S = 0.42X + 0.01
ACCURACY	X = 0.56C + 0.01	X = 0.41C + 0.11	X = 0.44C + 0.30	X = 0.54C + 0.06
TAP WATER				
SINGLE-ANALYST PRECISION	SR = 0.29X - 0.01	SR = 0.42X - 0.01	SR = 0.24X - 0.06	SR = 0.33X - 0.04
OVERALL PRECISION	S = 0.53X - 0.00	S = 0.44X + 0.04	S = 0.29X + 0.00	S = 0.38X + 0.02
ACCURACY	X = 0.54C - 0.02	X = 0.88C + 0.09	X = 0.71C - 0.07	X = 0.70C - 0.05
SURFACE WATER				
SINGLE-ANALYST PRECISION	SR = 0.24X - 0.01	SR = 0.34X + 0.04	SR = 0.40X - 0.16	SR = 0.27X - 0.04
OVERALL PRECISION	S = 0.47X - 0.00	S = 0.49X - 0.02	S = 0.60X - 0.12	S = 0.42X - 0.06
ACCURACY	X = 0.65C + 0.01	X = 0.71C - 0.03	X = 0.67C + 0.05	X = 0.60C + 0.02
WASTEWATER (C-94)				
SINGLE-ANALYST PRECISION	SR = 0.30X - 0.01	SR = 0.24X + 0.00	SR = 0.25X - 0.04	SR = 0.25X - 0.06
OVERALL PRECISION	S = 0.44X - 0.01	S = 0.35X + 0.00	S = 0.36X - 0.08	S = 0.42X - 0.04
ACCURACY	X = 0.67C + 0.02	X = 0.71C - 0.05	X = 0.72C - 0.05	X = 0.67C + 0.01
WASTEWATER (C-95)				
SINGLE-ANALYST PRECISION	SR = 0.31X + 0.01	SR = 0.25X + 0.12	SR = 0.27X + 0.01	SR = 0.39X - 0.01
OVERALL PRECISION	S = 0.40X - 0.00	S = 0.39X - 0.00	S = 0.48X - 0.17	S = 0.50X + 0.04
ACCURACY	X = 0.72C - 0.01	X = 0.77C + 0.02	X = 0.71C + 0.14	X = 0.95C - 0.05
WASTEWATER (C-96)				
SINGLE-ANALYST PRECISION	SR = 0.20X - 0.00	SR = 0.36X - 0.07	SR = 0.34X - 0.17	SR = 0.37X - 0.07
OVERALL PRECISION	S = 0.41X - 0.02	S = 0.45X + 0.08	S = 0.42X - 0.04	S = 0.44X - 0.05
ACCURACY	X = 0.70C + 0.01	X = 0.71C + 0.16	X = 0.69C + 0.20	X = 0.83C - 0.11

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

- Operational problems included variable HPLC column performance and differences in fluorescence detector response for the general types of detectors employed. Some of the PNA's are light sensitive, in particular, dibenzo(a,h)anthracene and benzo(g,h,i)perylene, thus exposure to light should be minimized.

SECTION 3

DESCRIPTION OF STUDY

SELECTION OF PARTICIPATING LABORATORIES

Potential participants identified from a list of 100 laboratories provided by USEPA were informed of the impending study. Forty-one laboratories responded to the request for technical and cost proposals. Proposals were carefully reviewed and then ranked on the basis of technical experience and facilities. The laboratories selected for awards represented a mix of those showing average to above average analytical capabilities and are listed below:

Analytical Development Company
1875 Willow Park Way
P.O. Box 744
Monument, CO 80132

Arthur D. Little, Inc.
25 Acorn Pike
Cambridge, MA 02140

Environmental Research Group, Inc.
117 N. First
Ann Arbor, MI 48103

Environmental Science and Engineering
P.O. Box 13454
Gainesville, FL 32604

Foremost Foods Inc.
6363 Clark Avenue
Dublin, CA 94566

Gulf South Research Institute
P.O. Box 26518
New Orleans, LA 70186

Hydroscience, Inc.
9041 Executive Park Drive
Knoxville, TN 37919

ITT Research Institute
10 West 35th Street
Chicago, IL 60616

Mead Technology Laboratories
P.O. Box 12652
Research Triangle Park, NC 27709

Metpath
One Malcom Avenue
Teterboro, NJ 07608

Midwest Research Institute
425 Volker Boulevard
Kansas City, MO 64110

Monsanto Research Corporation
P.O. Box 8, Sta. B
Dayton, OH 45407

Southern Research Institute
2000 Ninth Avenue, S.
Birmingham, AL 35205

Southwest Research Institute
8500 Culebra Road
P.O. Drawer 25810
San Antonio, TX 78284

SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025

Systems, Science, and Software
3398 Carmel Mountain road
San Diego, CA 92121

U.S. Coast Guard Research &
Development Center
Avery Point
Groton, CT 06340

U.S. Environmental Protection
Agency
EMSL
Cincinnati, OH 45268

West Coast Technical Service
17605 Fabrica Way, Suite D
Cerritos, CA 90701

TEST DESIGN

The test design was patterned after Youden's non-replicate design(3) for collaborative evaluation of precision and accuracy for analytical methods. According to Youden's design, samples are analyzed in pairs, with each sample of a pair having a slightly different concentration of the constituent of interest. The analyst is directed to do a single analysis and report one value for each sample, as if for a normal routine sample.

Prior to the start of the formal interlaboratory study, a preliminary study was conducted to enable the participants to gain experience with the analytical and sample handling procedures. Each analyst analyzed one trial Youden pair sample and then attended a prestudy conference at USEPA in Cincinnati, Ohio, to discuss the findings, the method, and the factors that could affect the quality of data. The major discussions concerned cleanup of solvent extracts, HPLC conditions, and problems with the UV and fluorescence detectors. A number of recommendations were offered for improving method performance, and these are summarized in Appendix B.

Test samples were prepared as liquid concentrates in sealed glass ampules and presented to the analyst with complete instructions. The analyst was required to add an aliquot of each concentrate to a volume of distilled water and to a volume of each of the five water types described below. The analysis in distilled water was used to evaluate the analyst's ability to use the method on a sample free of interferences. Analyses in other water types were intended to reveal effects of various chemical matrices on the method's performance. Major elements of the test design were:

1. Three Youden pairs of samples were analyzed for each parameter and the concentrations within each pair deviated at least ± 5 percent but no more than ± 20 percent from the mean of the pair. The three Youden pairs were spread over a usable and realistic range, the lowest pair being somewhat above the minimum detection limit.
2. Samples of approximately 2 mL were supplied as liquid concentrates in acetone contained in 10-mL glass ampules. One -mL aliquots of the concentrates were added to the test waters according to the instructions. Water samples including distilled water were analyzed with and without added increment and the added level determined by difference. Concentrations were reported in terms of μg/L with only one value reported for each sample.
3. Analyses were conducted in six types of water as follows:
    - a. Distilled water
    - b. A municipal drinking water
    - c. A surface water vulnerable to synthetic chemical contamination, as from a river
    - d. Three industrial wastewaters from industries that normally would be regulated for the priority pollutants under study.
4. The participating laboratories were provided with a write-up of method of analysis, chemical standards required for calibration, and samples of the three industrial wastewaters. Each participating laboratory was responsible for securing samples of the other three test waters.

SECTION 4

EXPERIMENTAL PROCEDURES

PREPARATION OF YOUDEN PAIR CONCENTRATES

Stock solutions of the Category 9 compounds were prepared by dissolving accurately weighed amounts of the chemicals in acetone. The sample concentrates were then prepared by diluting measured amounts of the stock solutions to larger volumes. As noted, the concentration of a given compound in each Youden pair was adjusted so that it differed by at least ± 5 percent, but was no greater than ± 20 percent from the mean of the pair.

The concentrations of the diluted solutions were confirmed by liquid chromatographic analysis. Chromatographic conditions were the same as those described in Method 610. Sample concentrates of approximately 2 mL of the diluted solutions were then prepared in 10-mL glass ampules and flame-sealed. The concentrations, µg/mL, of the Category 9 compounds in the ampules are given in Table 2.

STABILITY OF YOUDEN PAIR CONCENTRATES

The stability of the Youden pairs of Category 9 compounds was studied over a 90-day period. Triplicate samples of each Youden pair concentrate were selected at random from the lot of ampules and analyzed at 0, 45, and 90 days. The stability of the samples was considered satisfactory. With the exception noted for fluorine ampules Numbers 2 and 6 (see Table 2 footnote), deviation of the analyzed values from the true values did not exceed ± 17 percent at the end of the 90-day period.

TABLE 2. CALCULATED CONCENTRATIONS OF CATEGORY 9 COMPOUNDS IN AMPULES, μg/mL

Component	Ampule Number 1	2	3	4	5	6
Naphthalene	10.0	13.0	110.0	90.0	335.0	375.0
Acenaphthylene	10.0	15.0	110.0	90.0	425.0	375.0
Acenaphthene	10.0	12.0	120.0	95.0	235.0	260.0
Fluorene	10.0	13.0*	90.0	115.0	270.0	175*
Phenanthrene	5.0	6.0	60.0	50.0	205.0	280.0
Anthracene	10.0	14.0	70.0	85.0	400.0	350.0
Fluoranthene	0.30	0.4	4.0	3.0	15.0	12.0
Pyrene	2.0	2.6	24.0	28.0	90.0	75.0
Benzo(a)anthracene	0.50	0.60	6.0	5.0	12.0	16.0
Chrysene	2.0	3.0	20.0	28.0	60.0	40.0
Benzo(b)fluoranthene	0.20	0.30	3.0	2.0	8.0	11.0
Benzo(k)fluoranthene	0.12	0.15	1.4	1.1	4.0	6.0
Benzo(a)pyrene	0.20	0.30	2.0	2.8	12.0	15.0
Dibenzo(a,h)anthracene	0.50	0.70	6.5	5.0	24.0	20.0
Benzo(g,h,i)perylene	1.00	1.40	14.0	10.0	35.0	50.0
Indeno(1,2,3-cd)pyrene	0.75	1.0	5.0	6.0	22.0	15.0

* Fluorene analyses for these ampule samples indicate that the calculated concentrations are incorrect. The analyzed values are approximately 25.4 and 463.0 μg/mL, respectively, for ampules 2 and 6 and were used in the statistical analyses in lieu of the calculated values.

COLLECTION OF INDUSTRIAL WASTEWATER EFFLUENTS

Chemical industries producing Category 9 compounds or utilizing them in chemical processes were identified from Synthetic Organic Chemicals - U.S. Production and Sales 1974-77, U.S. International Trade Commission, and the 1979 Directory of Chemical Producers in the United States.

Since Method 610 may eventually be used by industries seeking permits issued by the National Pollutant Discharge Elimination System under the Clean

Water Act, plants using good technology in their wastewater treatment facilities were selected for sampling. Attempts were made to obtain wastewater samples from both users and producers of the various category compounds. The appropriateness of a particular company's wastewater was first assessed by discussions with technical personnel of that company. If on the basis of these discussions, it appeared that the plant's effluent might be suitable for the program, a 1-gallon sample of the effluent was sent to BCL for a preliminary analysis. The effluent was judged to be suitable for the method study if the analysis showed no major interferences or high background of the chemical parameters of interest that might nullify analytical data obtained for the lowest Youden pair concentrates. Approximately 55 gallons of acceptable wastewater effluents were collected in stainless steel drums at the plant sites by plant or BCL personnel and delivered to BCL by truck. Samples of wastewater were analyzed at BCL before and after spiking with the various Category 9 compounds. If the results of these analyses were satisfactory, 1-quart samples of the effluent were prepared for shipment to the participating laboratories. The contents of the drums were stirred vigorously during the bottling operation to ensure sample homogeneity. Samples were identified by coded labels as C-94, C-95, or C-96. A brief description of plant source and methods of wastewater treatments are given below. The results of BCL's analysis of the wastewater samples are given in Table 3.

Wastewater C-94 (SIC Code #2911*)--Effluent from a large oil refinery. Wastewater stream is treated in a biological treatment plant, clarified and then discharged into a river.

Wastewater C-95 (SIC Code #3312*)--Effluent from a blast furnace producing molten hot metal. Wastewater treatment scheme consists of coagulation, sedimentation, and recycle. Chemicals are added to the water to agglomerate the small suspended solids into larger particles. The solids settle to the bottom of the clarifiers, and this sludge is removed and dewatered. The clean effluent is cooled and 95 percent is recycled for top gas scrubbing and 5 percent is blown down to a river.

Wastewater C-96 (SIC Code #3112*)--Wastewater stream is the combined effluents from a coke oven and blast furnace operation. The waste stream is treated to agglomerate suspended solids and sent to settling ponds. Effluent from the ponds is clarified and then discharged into a river.

TABLE 3. BACKGROUND ANALYSES OF WASTEWATER SAMPLES FOR CATEGORY 9 COMPOUNDS, μg/L

Compound	Oil Refinery C-94	Blast Furnace, C-95	Coke Oven C-96
Naphthalene	<1	<1	<1
Acenaphthylene	<1	<1	<1
Acenaphthene	9.4	<1	<1
Fluorene	2.7	ND	0.9
Phenanthrene	<1	3.3	1.0
Anthracene	<1	4.1	ND
Fluoranthene	0.6	0.4	0.1
Pyrene	4.2	2.7	0.28
Benzo(a)anthracene	1.0	0.08	ND
Chrysene	<0.1	ND	0.32
Benzo(b)fluoranthene	<0.1	ND	0.06
Benzo(k)fluoranthene	<0.1	ND	0.03
Benzo(a)pyrene	<0.2	ND	0.08
Dibenzo(a,h)anthracene	<0.1	0.04	0.09
Benzo(g,h,i)perylene	<0.2	ND	0.21
Indeno(1,2,3-cd)pyrene	<0.1	ND	0.07

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* Standard Industrial Classification Code Number.

DISTRIBUTION OF SAMPLES

Each laboratory was provided with the following materials:

(1) Six Youden pair ampules of each of three concentration levels, for a total of 36 ampule for preparation of samples;

(2) Seven 1-quart samples of three types of industrial wastewater effluents, a total of 21 samples;

(3) Standards of the 16 PNA's;

(4) A copy of Method 610;

(5) A form for reporting data; and

(6) A questionnaire requesting description of difficulties encountered with the analytical method and suggestions for improvement of the method.

The laboratories were instructed to add a measured quantity of the contents of the ampules to test waters by the following procedure:

> Place a magnetic stirbar in the sample bottle, add 1 mL of the solution in the ampule, cap and stir 15 minutes using a magnetic stirrer. Transfer the contents of the bottle to a 2-liter separatory funnel and proceed with the analysis as described in Method 610. In calculating results, assume the volume of the sample to be one liter.

Standards of the PNA's were supplied to the laboratories because of the difficulty of obtaining PNA's of known purity and chemical structure. Some of the more complex PNA's were not readily available in this country at the time of the study and extensive delays in the program may have occured if each laboratory had been required to procure their PNA standards. The purities and structure identities of the standards supplied to the laboratories were confirmed by HPLC-fluorescence and GC-MS techniques.

TREATMENT OF DATA

The study's objective was met through the use of statistical analysis techniques designed to extract and summarize the relevant information about accuracy and precision from the data reported by the participating laboratories. The statistical techniques employed in the data reduction process are similar to ASTM techniques.

The algorithms required to perform the statistical analyses have been integrated into a system of computer programs referred to as IMVS. The analyses performed by IMVS include tests for the rejection of outliers (laboratories and individual data points), summary statistics by concentration level for mean recovery (accuracy), overall and single-analyst standard deviation (precision), determination of the linear relationship between mean recovery and concentration level, determination of the linear relationship between the precision statistics and mean recovery, and a test for the effect of water type on accuracy and precision.

A detailed description of each of the statistical analysis procedures is presented below.

REJECTION OF OUTLIERS

Since the objective of the statistical analyses is to summarize the general behavior of the method in terms of accuracy and precision, it is important to identify data points which are inconsistent with the majority of the data. These data points should be deleted from the analysis because they can lead to values of summary statistics which are not representative of the general behavior of the method. However, some erratic behavior in the data may be directly related to some facet of the method under the study. Therefore, inconsistent data points should not be removed indiscriminately, and any points that are removed should be clearly identified since further investigation of the analytical conditions related to the outliers might be of value. In some cases the data points which are deleted may actually be closer to the true value than the retained data. This is consistent since outliers are judged relative to the average value of the data and not with respect to the true value. Data rejected as outliers for this study as a result of any of the following tests for outliers have been identified by the symbol "*" in the raw data tables.

Youden's Laboratory Ranking Procedure

In some cases, the analytical values reported by a specific laboratory are so consistently high or low that a large systematic error may be attributed to that laboratory. These data are not representative of the method and should be rejected. Youden's(3) ranking test for outlying laboratories was applied separately to data from each of the waters used in this study. Since six water types were used in this study, the laboratory ranking procedure was applied to these six different subsets of the data. Each laboratory ranking test was performed at the 5 percent level of significance.

The Youden laboratory ranking procedure requires a complete set of data from every laboratory within a given water type. Missing data from laboratory "i" for water type "j" were replaced by the following procedure. Letting X_{ijk} denote the reported measurement from laboratory "i" for water type "j" and concentration level C_k, it is assumed that

$$X_{ijk} = \beta_j \, . \, C_k^{\gamma_j} . \, L_i \, . \, \varepsilon_{ijk}$$

where β_j and γ_j are fixed parameters which determine the effect of water type "j", L_i is the systematic error due to laboratory "i" and ε_{ijk} is the random within laboratory error. Taking natural logarithms, it follows that

$$\ell n \, X_{ijk} = \ell n \, \beta_j + \gamma_j \, \ell n \, C_k + \ell n \, L_i + \ell n \, \varepsilon_{ijk}$$

which is a linear regression model with dependent variable $\ell n \, X_{ijk}$ and independent variable $\ell n \, C_k$. Details and justification for this model are discussed in the section "Comparison of Accuracy and Precision Across Water Types."

The natural logarithms of the individual laboratory's data were regressed against the natural logarithms of the true concentration levels for the six ampules in each water type. The predicted values $\widehat{\ell n \, X}_{ijk}$ were obtained from the regression equation, and the missing values for X_{ijk} were estimated by $X_{ijk} = \exp(\widehat{\ell n \, X}_{ijk})$, where exp(x) denotes the constant e raised to the power X.

If the ranking test rejected a laboratory for a specific water type, then all the laboratory's data for that water type were rejected as outliers. The rejected values were excluded from all the remaining analyses. In addition, after completion of the laboratory ranking procedure, the predicted values created to fill in for the missing data were rejected and excluded from further analyses for all laboratories.

Individual Outliers

The data remaining after the laboratory ranking procedure were grouped by water type. For each water type, the data were broken down into six subsets defined by the six concentration levels (ampules) used in the study. For each subset of the data, all missing, zero, "less than," and "nondetect" data were rejected. Next, the test for individual outliers constructed by Thompson(5), and suggested in the ASTM Standard Practice D2777-77, was applied to the data using a 5-percent significance level. If an individual data point was rejected based on this test, it was removed from the subset, and the test was repeated using the remaining data in the subset. This process was continued until no additional data could be rejected.

STATISTICAL SUMMARIES DATA

Several summary statistics were calculated using the data remaining for each concentration level after the outlier rejection tests were performed. These summary statistics include: the number of retained data points, the mean recovery, accuracy as a percent relative error, the absolute overall standard deviation, the percent relative overall standard deviation, the absolute single-analyst standard deviation, and the percent relative single-analyst standard deviation. The basic formulas used to calculate these statistics are presented below (X_1, X_2,..., X_n denote the values of the n retained data points for a specific concentration level):

Mean Recovery (X):

$$X = \frac{1}{n} \sum_{i=1}^{n} X_i$$

The usual concentration notation for mean recovery is $\overline{X}$. However, the symbol X is used in this report to be consistent with the IMVS output.

Accuracy as a Percent Relative Error:

$$\text{Percent RE} = \frac{X - \text{True Value}}{\text{True Value}} \times 100$$

Overall Standard Deviation:

$$S = \sqrt{\frac{1}{n - 1}\sum_{i=1}^{n} (X_i - X)^2}$$

and

Percent Relative Overall Standard Deviation:

$$\text{Percent RSD} = \frac{S}{X} \times 100$$

The overall standard deviation S indicates the precision associated with measurements generated by a group of laboratories. This represents the broad variation in the data collected in an interlaboratory study. However, a measure of how well an individual analyst can expect to perform in his own laboratory is another important measure of precision. This single-analyst precision, denoted by SR, was estimated for each Youden pair by

$$SR = \sqrt{\frac{1}{2(m - 1)} \sum_{i=1}^{m} (D_i - \overline{D})^2}$$

where

m = the number of complete sets of Youden pair observations remaining after outliers have been removed,

D_i = the difference between the observations in the ith Youden pair

and

$\overline{D}$ = average of the D_i values.

The percent relative single-analyst standard deviation was calculated by

$$\text{Percent RSD-SR} = \frac{SR}{X^*} \times 100$$

where X* is the average of the two mean recovery statistics corresponding to the two concentration levels defining the particular Youden pair.

These summary statistics provide detailed information on the accuracy and precision of the data obtained for each concentration level. One objective of the statistical analysis of the data is to summarize the information about accuracy and precision which is contained in the statistics.

A systematic relationship often exists between the mean recovery (X) and the true concentration level (C) of the analyte in the sample. In addition there are often systematic relationships between the precision statistics (S and SR) and the mean recovery (X). Usually these systematic relationships can be adequately approximated by a linear relationship (i.e. by a straight line). Once these straight lines are established, they can be used to conveniently summarize the behavior of the method within a water type, and they can aid in comparing the behavior of the method across water types. In addition they can be used to obtain estimates of the accuracy and precision at any concentration level within the applicable range studied. They can also be used to predict the behavior of the method when used under similar conditions. These important relationships are discussed below.

STATEMENT OF METHOD ACCURACY

The accuracy of the method is characterized by the relationship of the mean recovery (X) to the true concentration (C) of the analyte in the water sample. In order to obtain a mathematical expression for this relationship, a regression line of the form

$$X = a + b \cdot C \qquad (1)$$

was fitted to the data by regression techniques.

The true concentration values often vary over a wide range. In such cases, the mean recovery statistics associated with the larger concentration values tend to dominate the fitted regression line producing relatively larger errors in the estimates of mean recovery at the lower concentration values. In order to eliminate this problem, a weighted least squares technique was used to fit the mean recovery data to the true concentration values. The weighted least-squares technique was performed by dividing both sides of Equation (1) by C resulting in Equation (2)

$$\frac{X}{C} = a \cdot \frac{1}{C} + b \qquad (2)$$

The (X/C) values were regressed against the (1/C) values using ordinary least squares to obtain estimates for the values of a and b. (This is equivalent to performing a weighted least squares with weights $w = 1/C^2$; see Reference (6), page 108 for details.) Equation (2) can easily be converted to the desired relationship given by Equation (1). The intercept (b) from Equation (2) becomes the slope (b) for Equation (1) and slope (a) from Equation (2) becomes the intercept (a) for Equation (1). Equation (1) can be used to calculate the percent recovery over the applicable range of concentrations used in the study.

The percent recovery is given by

$$\text{Percent Recovery} = \left[\frac{a + b \cdot C}{C}\right] \times 100 = \left[\frac{a}{C} + b\right] \times 100$$

If the absolute value of the ratio (a/C) is small relative to the slope (b) for the low concentration levels used in the study, then the percent recovery can be approximated by b x 100. For example, suppose the true concentration values range from 25 μg/L to 515 μg/L, and the fitted line is given by $X = 0.20 + 0.85 \cdot C$. The percent recovery would be approximated by 0.85 x 100 = 85 percent over the specified range of 25 μg/L to 515 μg/L.

If the ratio (a/C) is not small relative to the slope (b), then the percent recovery depends upon the true concentration (C), and it must be evaluated at each concentration value within the specified range.

STATEMENT OF METHOD PRECISION

The precision of the method is characterized by the relationships between precision statistics (S and SR) and mean recovery (X). In order to obtain a mathematical expression for these relationships, regression lines of the form

$$S = d + e \cdot X \tag{4}$$

and

$$SR = f + g \cdot X^* \tag{5}$$

were fitted to the data by regression techniques.

As discussed previously with respect to accuracy, the values of X and X* often vary over a wide range. In such cases, the standard deviation statistics associated with the larger mean recovery values will dominate the regression lines. This will produce relatively larger errors in the estimates of S and SR at the lower mean recovery values. Therefore, a weighted least squares technique was also used to establish the values of the parameters d, e, f, and g in Equations (4) and (5). The weighted least squares technique was performed by dividing both sides of Equation (4) by X resulting in Equation (6)

$$\frac{S}{X} = d \cdot \frac{1}{X} + e \tag{6}$$

and by dividing both sides of Equation (5) by X* resulting in Equation (7)

$$\frac{SR}{X^*} = f \cdot \frac{1}{X^*} + g \tag{7}$$

The (S/X) values were regressed against the (1/X) values and the (SR/X*) values were regressed against the (1/X*) values using ordinary least squares to obtain estimates for the parameters d, e, f, and g.

Equations (4) and (5) were obtained from Equations (6) and (7) in a manner similar to that discussed for mean recovery. The slope (d) for Equation (6) is the intercept (d) for Equation (4), and the intercept (e) for Equation (6) is the slope (e) for Equation (4). Similarly, the slope (f) for Equation (7) is the intercept (f) for Equation (5), and the intercept (g) for Equation (7) is the slope (g) for Equation (5).

Given Equations (4) and (5), the percent relative overall standard deviation and the percent relative single-analyst standard deviation are

$$\text{Percent RSD} = \left[\frac{d}{X} + e\right] \times 100 \qquad (8)$$

and

$$\text{Percent RSD-SA} = \left[\frac{f}{X^*} + g\right] \times 100 \qquad (9)$$

respectively. If the absolute value of the ratio (d/X) is small relative to the slope (e), then the percent relative overall standard deviation can be approximated by (e x 100) over the applicable range of mean recovery values. Similarly if the ratio (f/X*) is small relative to the slope (g), then the percent relative single-analyst standard deviation can be approximated by (g x 100) over the applicable range of mean recovery values. If the ratios (d/X) and (f/X*) are not small relative to the slopes (e) and (f), then the percent relative standard deviations depend upon the values of the mean recovery statistics X and X*, and they should be evaluated separately for each value of X and X*.

COMPARISON OF ACCURACY AND PRECISION ACROSS WATER TYPES

It is possible that the accuracy and precision of Method 610 depend upon the type of water being analyzed. The summary statistics X, S, and SR are calculated separately for each concentration level within each water type. They can be compared across water types in order to obtain information about the effects of water type on accuracy and precision. However, the use of these summary statistics in this manner has several disadvantages. First, it is cumbersome since there are 36 mean recovery statistics (X) (6 concentrations x 6 waters), 36 precision statistics (S), and 18 precision statistics (SR) calculated for each compound. Comparison of these statistics across concentration levels and across water types becomes unwieldy. Second, the statistical properties of this type of comparison procedure are difficult to determine. Finally, due to variation associated with X, S, and SR, comparisons based on these statistics can lead to inconsistent conclusions about the effect of water type. For example, distilled water may produce a significantly lower value than surface water for the precision statistic S at a high concentration, but a significantly higher value for S at a low concentration.

An alternative approach, described in detail(7) has been developed to test for the effects of water type. This alternative approach is based on the concept of summarizing the average effect of water type across concentration levels rather than studying the local effects at each concentration level. If significant differences are established by this alternative technique, then the summary statistics can be used for further local analysis.

The test for the effect of water type is based on the following statistical model. If X_{ijk} denotes the measurement reported by laboratory "i", for water type "j", and ampule k, then

$$X_{ijk} = \beta_j \cdot C_k^{\gamma_j} \cdot L_i \cdot \varepsilon_{ijk} \quad . \quad \begin{array}{l} i = 1,2,\ldots, n \\ j = 1,2,\ldots, 6 \\ k = 1,2,\ldots, 6 \quad . \end{array} \tag{10}$$

The model components β_j and γ_j are fixed parameters which determine the effect of water type "j" on the behavior of the observed measurements (X_{ijk}). The parameter C_k is the true concentration level associated with ampule k. If the observed measurements are plotted versus concentration on a log-log scale, the data will plot approximately along a straight line. The intercept for the line is log β_j and the parameter γ_j is the slope of the line. The model component L_i is a random factor which accounts for the systematic error associated with laboratory "i". The model component ε_{ijk} is the random factor which accounts for the intralaboratory error.

The model is designed to approximate the global behavior of the data. The multiplicative structure was chosen because of two important properties. First, since the model describes a straight line relationship on a log-log scale, it allows for a possible curvilinear relationship between the data (X_{ijk}) and the true concentration level C_k through the use of the exponent γ_j on C_k. This makes the model more flexible in comparison to straight line models. Second, as will be seen below, there is an inherent increasing relationship between the variability in the data and the concentration level C_k in this model. This property is important because it is typical of interlaboratory data collected under conditions where the true concentration levels vary widely.

Accuracy is related directly to the mean recovery or expected value of the measurements (X_{ijk}). The expected value for the data modeled by Equation (10) is

$$E(X_{ijk}) = \beta_j \cdot C_k^{\gamma_j} \cdot E(L_i \cdot \varepsilon_{ijk}) \tag{11}$$

Precision is related to the variability in the measurements (X_{ijk}). The variance of the data modeled by Equation (10) is

$$\mathrm{Var}(X_{ijk}) = \left[\beta_j \; C_k^{\;\gamma_j}\right]^2 \mathrm{Var}(L_i \cdot \varepsilon_{ijk}) \tag{12}$$

which is an increasing function of C_k.

The effect of water type on the accuracy and precision of Method 610 is determined by the values of the parameters (β_j) and (γ_j) in Equations (11) and (12). If the (β_j) and (γ_j) vary with j (i.e. vary across water type), then the accuracy and precision of the method also vary across water type.

In order to determine if these parameters do vary across water type and to compare their values, they must be estimated from the laboratory data using regression techniques. Equation (10) represents the basic model. However, taking natural logarithms of both sides of Equation (10), the following straight line regression model is obtained

$$\ell n\ X_{ijk} = \ell n\ \beta_j + \gamma_j\ \ell n\ C_k + \ell n\ L_i + \ell n\ \varepsilon_{ijk} \tag{13}$$

which can be analyzed using standard linear model analysis techniques. The parameter Ln β_j is the intercept and γ_j the slope of the regression line associated with water type "j". It is assumed that $\ell n\ L_i$ is normally distributed with mean 0 and variance σ_L^2, and that $\ell n\ \varepsilon_{ijk}$ is normally distributed with mean 0 and variance σ_ε^2, and that the ($\ell n\ L_i$) and ($\ell n\ \varepsilon_{ijk}$) terms are independent.

Based on Equation (13), the comparison of water types reduces to the comparison of straight lines. Distilled water is viewed as a control, and each of the remaining lines is compared directly to the line for distilled water.

Using the data on the log-log scale and regression techniques, the parameters $\ell n\, \beta_j$ (and hence β_j) and γ_j can be estimated. The estimates are then used to test the null hypothesis that there is no effect due to water type. The formal null and alternative statistical hypotheses H_O and H_A are given by

$$H_O:\ \ell n\, \beta_j - \ell n\, \beta_1 = 0 \text{ and } \gamma_j - \gamma_1 = 0 \text{ for } j = 2,3,4,5,6$$

versus

$$H_A:\ \ell n\, \beta_j - \ell n\, \beta_1 \neq 0 \text{ and/or } \gamma_j - \gamma_1 = 0 \text{ for some } j = 2,3,4,5,6 \quad .$$

The test of null hypothesis H_O against the alternative hypothesis H_A is based on an F-statistic derived from standard linear model theory. The probability of obtaining a value of an F-statistic as large as the value which was actually observed (F OBS), denoted by $P(F > F\ OBS)$, is calculated under the assumption that H_O is true. The null hypothesis H_O is rejected in favor of H_A if $P(F > F\ OBS)$ is less than 0.05.

If H_O is rejected, then some linear combination of the differences $\ell n\, \beta_j - \ell n\, \beta_1$ and $\gamma_j - \gamma_1$ is statistically different from zero. However, this does not guarantee there will be a statisticlaly significant direct effect attributable to any specific water type since the overall F test can be overly sensitive to a minor systematic effect common to several water types. The effect due to a specific water type is judged to be statistically significant only if one of the differences $\ell n\, \beta_j - \ell n\, \beta_1$ and/or $\gamma_j - \gamma_1$ is statistically different from zero. This is determined by checking the simultaneous 95-percent confidence intervals which are constructed for each of these differences. Each true difference can be stated to lie within its respective confidence interval with 95-percent confidence. If zero is contained within the confidence interval, then there is no evidence that the corresponding difference is significantly different from zero.

If at least one of the confidence intervals for the differences $\ell n\, \beta_j - \ell n\, \beta_1$ or $\gamma_j - \gamma_1$ fails to include zero, then the statistical significance of the effect due to water type has been established. However, establishment of a statistically significant effect due to water type does not necessarily mean that the effect is of practical importance. Practical importance is related to the size and interpretation of the difference.

The interpretation of the differences involves comparing the mean recovery and standard deviation of the (X_{ijk}) data for each water type to the mean recovery and standard deviation obtained for distilled water. These comparisons are made on a relative basis. The mean recovery for water type "j" is given by Equation (11). The mean recovery for water type "j" is compared to that for distilled water (j=1) on a relative basis by the ratio

$$\frac{E(X_{ijk})}{E(X_{i1k})} = \frac{\beta_j C_k^{\gamma_j} E(L_i \cdot \varepsilon_{ijk})}{\beta_1 C_k^{\gamma_1} E(L_i \cdot \varepsilon_{i1k})} = \frac{\beta_j}{\beta_1} C_k^{\gamma_j - \gamma_1} \qquad (14)$$

(The ratio of the standard deviations would be equivalent to Equation (14) and therefore the interpretation of the effect on precision is the same as that for the effect on mean recovery.)

The ratio in Equation (14) is a measure of the relative difference in mean recovery between water type "j" and distilled water. It is composed of two parts (a) β_j/β_1, which is independent of the true concentration level (i.e. the constant bias), and (b) $C_k^{\gamma_j - \gamma_1}$ which depends upon the true concentration level (i.e. the concentration dependent bias). If $\gamma_j - \gamma_1$ is zero, then the relative difference in mean recovery is just β_j/β_1, which is independent of concentration level C_k. It can then be stated that the mean recovery of water type "j" is (β_j/β_1) x 100 percent of the mean recovery for distilled water. If $\gamma_j - \gamma_1$ is not zero, then the mean recovery of water type "j" is $((\beta_j/\beta_1).C_k^{\gamma_j - \gamma_1})$ x 100 percent of that for distilled water, and therefore depends upon the true concentration level C_k.

In order to illustrate these points, consider the following example. Suppose that a significant F-value has been obtained, and the confidence intervals for all the differences contain zero except for water type 5. Suppose for water type 5, the point estimate for $\ell n\ \beta_5 - \ell n\ \beta_1$ is -0.38 and the confidence interval for $\ell n\ \beta_5 - \ell n\ \beta_1$ is (-0.69, -0.07). Suppose the point estimate for $\gamma_5 - \gamma_1$ is 0.07, and the confidence interval for $\gamma_5 - \gamma_1$ is (-0.04, 0.18). In this case, a statistically significant effect due to water type has been established which involves only water type 5. The practical significance of this effect is judged by considering Equation

(14). The ratio of mean recoveries for water type 5 and distilled water is given by

$$\frac{E(X_{i5k})}{E(X_{i1k})} = \frac{\beta_5}{\beta_1} C_k^{\gamma_5 - \gamma_1} \qquad (15)$$

and the ratio of the standard deviations is given by

$$\sqrt{\frac{Var(X_{i5k})}{Var(X_{i1k})}} = \frac{\beta_5}{\beta_1} C_k^{\gamma_5 - \gamma_1} . \qquad (16)$$

Since the confidence interval for $\gamma_5 - \gamma_1$ contains zero, this difference is assumed to be insignificant and is set to zero. Therefore, Equations (15) and (16) reduce to β_5/β_1. The point estimate for $\ell n\ \beta_5 - \ell n\ \beta_1$ was -0.38. Therefore, the point estimate for β_5/β_1 is 0.68, and the mean recovery for water type 5 is estimated to be 68 percent of the mean recovery for distilled water. Similarly, the standard deviation for the data for water type 5 is estimated to be 68 percent of the standard deviation for distilled water. Since the 95 percent confidence interval for $\ell n\ \beta_5 - \ell n\ \beta_1$ was (-0.69,-0.07), any value in the interval (0.50, 0.93) is a reasonable estimate for β_5/β_1, and the mean recovery (standard deviation) for water type 5 can be claimed to be from 50 percent to 93 percent of the mean recovery (standard deviation) for distilled water. The practical significance of the effect due to water type 5 would depend upon the importance of a mean recovery (standard deviation) which is between 50 percent and 93 percent of the mean recovery (standard deviation) observed for distilled water.

The comparison of accuracy and precision across water types just discussed, is based on the assumption that Equation (10) approximately models the data. It is clear that in practical monitoring programs of this type such models cannot represent the data completely in every case. This analysis, therefore, is viewed as a screening procedure which identifies those cases where differences in water types are likely to be present. A more detailed, local analysis can then be pursued using the basic summary statistics for precision and accuracy.

SECTION 5

RESULTS AND DISCUSSION

The statistical analysis procedures described in Section 4 have been applied to the raw data shown in Appendix C for the 16 laboratories participating in this interlaboratory study. The results of those analyses with respect to the performance of Method 610 are discussed in this section.

STATISTICAL SUMMARIES

The basic summary statistics discussed in Section 4 were calculated for each of the 16 PNAs and are summarized in Tables 4 - 19. The number of outliers for each data set as determined by the ranking and individual outlier test ranged from zero to eight, and averaged about three outliers per data set. For all data for the sixteen compounds, 20 percent of the data was rejected.

REGRESSION EQUATIONS

Using the values contained in the summary statistics for the true concentrations, mean recoveries(X and X*), overall standard deviations (S), and single-analyst standard deviations (SR), the regression lines given by Equations 1, 4, and 5 were obtained for each compound and water type. These regression lines were summarized in Table 1 (see Section 2, pages 5 - 8).

Effects of Water Type

The multiplicative model (Equation 10) was fitted separately to the data for each compound in order to test for the effects due to water type. These analyses are summarized in Table 20. The detailed analysis of variance tables supporting these results are presented in Appendix D.

TABLE 4. STATISTICAL SUMMARY FOR NAPHTHALENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	13	12	12	12	13	12	13	14	11	12	13	13
TRUE CONC (C) UG/L	10.00	13.00	10.00	13.00	10.00	13.00	10.00	13.00	10.00	13.00	10.00	13.00
MEAN RECOVERY (X)	5.07	6.45	5.16	7.34	5.32	6.81	7.62	7.57	6.14	9.76	5.71	7.60
ACCURACY(%REL ERROR)	-49.33	-50.35	-48.38	-43.53	-46.83	-47.59	-23.76	-41.77	-38.61	-24.92	-42.92	-41.52
OVERALL STD DEV (S)	3.28	2.68	2.40	4.26	3.09	4.06	3.45	2.59	0.95	1.78	2.50	2.32
OVERALL REL STD DEV, %	64.64	41.51	46.55	58.07	58.19	59.54	45.27	34.19	15.43	18.20	43.85	30.45
SINGLE STD DEV, (SR)	2.12		2.47		3.42		2.81		1.30		2.34	
ANALYST REL DEV, %	36.75		39.53		56.43		36.97		16.40		35.13	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	13	14	13	13	14	14	14	15	12	12	15	15
TRUE CONC (C) UG/L	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00
MEAN RECOVERY (X)	55.81	56.29	61.38	59.29	62.76	54.97	67.23	65.04	66.15	57.15	61.25	63.67
ACCURACY(%REL ERROR)	-49.26	-37.46	-44.20	-34.12	-42.95	-38.92	-38.88	-27.73	-39.87	-36.50	-44.32	-29.26
OVERALL STD DEV (S)	24.58	26.03	24.90	22.32	22.49	27.12	29.00	20.18	25.40	15.04	31.00	29.10
OVERALL REL STD DEV, %	44.04	46.24	40.57	37.65	35.83	49.34	43.13	31.02	38.40	26.31	50.61	45.70
SINGLE STD DEV, (SR)	18.41		21.29		15.82		14.28		17.06		20.03	
ANALYST REL DEV, %	32.85		35.28		26.88		21.59		27.67		32.07	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	14	14	13	13	14	13	15	15	11	11	15	15
TRUE CONC (C) UG/L	335.00	375.00	335.00	375.00	335.00	375.00	335.00	375.00	335.00	375.00	335.00	375.00
MEAN RECOVERY (X)	196.37	200.58	174.41	235.18	201.62	227.67	207.10	221.12	188.54	202.24	206.46	256.65
ACCURACY(%REL ERROR)	-41.38	-46.51	-47.94	-37.29	-39.81	-39.29	-38.18	-41.04	-43.72	-46.07	-38.37	-31.56
OVERALL STD DEV (S)	79.41	82.95	71.52	84.45	72.10	103.99	77.65	76.67	59.57	56.36	58.96	107.36
OVERALL REL STD DEV, %	40.44	41.35	41.01	35.91	35.76	45.68	37.49	34.67	31.60	27.87	28.56	41.83
SINGLE STD DEV, (SR)	89.59		74.39		55.88		42.20		34.71		71.67	
ANALYST REL DEV, %	45.14		36.32		26.03		19.71		17.76		30.95	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 5. STATISTICAL SUMMARY FOR ACENAPHTHYLENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	14	13	12	12	11	12	13	13	13	13	12	13
TRUE CONC (C) UG/L	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00
MEAN RECOVERY (X)	5.37	7.71	4.57	7.92	5.30	8.87	7.44	10.60	6.79	10.44	6.79	9.72
ACCURACY(%REL ERROR)	-46.28	-48.57	-54.31	-47.23	-47.01	-40.89	-25.55	-29.32	-32.06	-30.40	-32.11	-35.22
OVERALL STD DEV (S)	2.95	3.42	2.02	3.31	1.65	2.83	2.32	3.42	2.61	2.79	2.80	2.86
OVERALL REL STD DEV, %	54.93	44.34	44.17	41.87	31.10	31.93	31.17	32.25	38.40	26.68	41.19	29.48
SINGLE STD DEV, (SR)	2.66		2.35		2.21		2.81		1.88		1.93	
ANALYST REL DEV, %	40.68		37.61		31.22		31.12		21.82		23.41	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	15	14	16	16	13	13	13	13	15	15	14	15
TRUE CONC (C) UG/L	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00
MEAN RECOVERY (X)	62.54	59.93	74.98	70.97	77.22	68.07	84.07	78.58	73.75	71.40	73.78	87.20
ACCURACY(%REL ERROR)	-43.15	-33.41	-31.84	-21.14	-29.80	-24.36	-23.58	-12.69	-32.95	-20.67	-32.93	-3.11
OVERALL STD DEV (S)	29.03	29.27	41.51	37.49	29.14	20.05	29.27	25.87	28.39	32.66	16.98	36.61
OVERALL REL STD DEV, %	46.42	48.85	55.36	52.82	37.74	29.46	34.81	32.92	38.50	45.75	23.02	41.98
SINGLE STD DEV, (SR)	16.80		35.29		23.63		10.94		31.03		19.51	
ANALYST REL DEV, %	27.44		48.36		32.52		13.45		42.75		24.24	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	14	15	16	15	13	12	12	14	13	13	14	12
TRUE CONC (C) UG/L	425.00	375.00	425.00	375.00	425.00	375.00	425.00	375.00	425.00	375.00	425.00	375.00
MEAN RECOVERY (X)	361.06	235.79	291.70	242.36	323.71	252.74	405.63	269.08	349.20	267.27	394.66	277.38
ACCURACY(%REL ERROR)	-15.05	-37.12	-31.36	-35.37	-23.83	-32.60	-4.56	-28.25	-17.83	-28.73	-7.14	-26.03
OVERALL STD DEV (S)	134.09	98.04	123.68	70.51	98.44	59.96	67.66	117.34	110.80	84.62	62.26	45.44
OVERALL REL STD DEV, %	37.14	41.58	42.40	29.09	30.41	23.72	16.68	43.61	31.73	31.66	15.78	16.38
SINGLE STD DEV, (SR)	129.63		77.43		66.43		87.22		66.41		37.98	
ANALYST REL DEV, %	43.44		29.00		23.05		25.86		21.54		11.30	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 6. STATISTICAL SUMMARY OF ACENAPHTHENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	11	9	10	8	9	10	8	11	10	10	10	9
TRUE CONC (C) UG/L	10.00	12.00	10.00	12.00	10.00	12.00	10.00	12.00	10.00	12.00	10.00	12.00
MEAN RECOVERY (X)	6.05	6.49	3.55	4.47	4.16	6.59	5.46	6.54	6.02	7.01	6.22	7.68
ACCURACY(%REL ERROR)	-39.55	-45.92	-64.53	-62.71	-58.41	-45.12	-45.35	-45.50	-39.78	-41.59	-37.82	-36.03
OVERALL STD DEV (S)	5.40	3.66	2.26	2.36	2.13	3.71	2.37	3.37	3.12	3.05	3.39	0.78
OVERALL REL STD DEV, %	89.40	56.45	63.63	52.70	51.11	56.35	43.43	51.54	51.86	43.57	54.51	10.22
SINGLE STD DEV, (SR)	3.24		1.44		2.36		1.30		1.85		2.23	
ANALYST REL DEV, %	51.64		35.94		44.00		21.65		28.45		32.08	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	13	13	13	12	12	12	14	12	12	13	15	14
TRUE CONC (C) UG/L	120.00	95.00	120.00	95.00	120.00	95.00	120.00	95.00	120.00	95.00	120.00	95.00
MEAN RECOVERY (X)	59.41	39.62	59.53	48.83	62.21	53.51	67.24	54.53	62.56	54.74	65.66	54.28
ACCURACY(%REL ERROR)	-50.49	-58.29	-50.40	-48.60	-48.16	-43.67	-43.96	-42.60	-47.87	-42.38	-45.28	-42.86
OVERALL STD DEV (S)	33.47	29.32	24.26	22.81	27.56	19.30	35.57	20.30	34.26	21.99	30.50	24.81
OVERALL REL STD DEV, %	56.34	73.99	40.76	46.71	44.30	36.07	52.90	37.23	54.77	40.17	46.45	45.70
SINGLE STD DEV, (SR)	17.24		17.11		11.97		18.01		17.77		21.30	
ANALYST REL DEV, %	34.81		31.58		20.69		29.57		30.29		35.51	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	13	13	13	13	11	12	14	14	13	11	15	14
TRUE CONC (C) UG/L	235.00	260.00	235.00	260.00	235.00	260.00	235.00	260.00	235.00	260.00	235.00	260.00
MEAN RECOVERY (X)	153.57	137.92	110.69	131.88	116.21	136.50	142.79	154.88	145.05	143.99	159.46	171.22
ACCURACY(%REL ERROR)	-34.65	-46.96	-52.90	-49.28	-50.55	-47.50	-39.24	-40.43	-38.27	-44.62	-32.14	-34.15
OVERALL STD DEV (S)	67.90	68.67	67.57	56.68	69.61	67.99	79.12	82.62	68.14	66.45	64.37	73.29
OVERALL REL STD DEV, %	44.22	49.79	61.04	42.98	59.90	49.81	55.41	53.35	46.98	46.15	40.36	42.80
SINGLE STD DEV, (SR)	65.24		33.71		20.65		55.88		26.59		35.39	
ANALYST REL DEV, %	44.77		27.79		16.34		37.54		18.40		21.41	

WATER LEGEND

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2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 7. STATISTICAL SUMMARY OF FLUORENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	15	14	12	12	11	12	12	12	11	11	11	10
TRUE CONC (C) UG/L	10.00	25.40	10.00	25.40	10.00	25.40	10.00	25.40	10.00	25.40	10.00	25.40
MEAN RECOVERY (X)	5.18	12.96	4.56	14.12	5.52	13.10	5.88	15.86	6.25	12.11	5.83	13.71
ACCURACY(%REL ERROR)	-48.22	-48.98	-54.42	-44.42	-44.80	-48.43	-41.15	-37.55	-37.47	-52.32	-41.68	-46.01
OVERALL STD DEV (S)	2.92	5.77	2.18	6.67	2.09	6.94	1.92	7.00	2.18	6.44	2.94	4.15
OVERALL REL STD DEV, %	56.42	44.52	47.75	47.27	37.82	52.98	32.56	44.14	34.92	53.20	50.35	30.24
SINGLE STD DEV, (SR)	2.91		3.55		2.86		4.37		4.57		3.60	
ANALYST REL DEV, %	32.06		38.00		30.76		40.17		49.76		36.88	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	15	15	13	13	13	13	12	12	11	11	12	12
TRUE CONC (C) UG/L	90.00	115.00	90.00	115.00	90.00	115.00	90.00	115.00	90.00	115.00	90.00	115.00
MEAN RECOVERY (X)	46.92	61.59	54.97	65.51	59.97	67.52	56.88	71.65	51.48	62.27	49.04	67.22
ACCURACY(%REL ERROR)	-47.87	-46.44	-38.92	-43.04	-33.37	-41.28	-36.80	-37.69	-42.80	-45.86	-45.51	-41.54
OVERALL STD DEV (S)	26.26	40.79	19.29	31.62	20.63	33.47	20.39	34.12	24.71	27.58	20.39	29.27
OVERALL REL STD DEV, %	55.98	66.22	35.10	48.27	34.40	49.56	35.85	47.63	48.00	44.30	41.57	43.54
SINGLE STD JEV, (SR)	21.96		15.03		17.56		16.82		9.17		15.72	
ANALYST REL DEV, %	40.48		24.96		27.55		26.17		16.13		27.04	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	14	15	13	13	13	13	13	13	9	10	12	11
TRUE CONC (C) UG/L	270.00	463.00	270.00	463.00	270.00	463.00	270.00	463.00	270.00	463.00	270.00	463.00
MEAN RECOVERY (X)	167.96	253.71	152.04	272.36	136.80	254.35	159.60	257.81	139.53	253.09	138.69	254.85
ACCURACY(%REL ERROR)	-37.79	-45.20	-43.69	-41.17	-49.33	-45.06	-40.89	-44.32	-48.32	-45.34	-48.63	-44.96
OVERALL STD DEV (S)	102.42	190.62	93.29	147.98	69.08	170.63	91.96	161.38	59.61	115.29	75.92	164.62
OVERALL REL STD DEV, %	60.98	75.13	61.36	54.33	50.50	67.08	57.62	62.60	42.72	45.55	54.74	64.59
SINGLE STD DEV, (SR)	95.25		59.09		95.14		57.08		59.28		82.53	
ANALYST REL DEV, %	45.18		27.85		48.65		27.35		30.20		41.94	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 8. STATISTICAL SUMMARY OF PHENANTHRENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	15	15	13	12	12	13	13	14	12	11	14	14
TRUE CONC (C) UG/L	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00
MEAN RECOVERY (X)	2.85	3.14	2.55	4.01	3.22	3.92	3.27	4.18	3.18	3.90	2.83	4.06
ACCURACY(%REL ERROR)	-42.93	-47.68	-49.08	-33.13	-35.63	-34.74	-34.65	-30.39	-36.32	-34.97	-43.40	-32.39
OVERALL STD DEV (S)	0.97	1.35	0.85	0.98	0.66	0.77	0.48	1.04	0.80	1.11	0.96	0.92
OVERALL REL STD DEV, %	34.04	43.09	33.25	24.50	20.51	19.69	14.74	24.92	25.23	28.47	33.79	22.77
SINGLE STD DEV, (SR)	0.88		0.93		0.47		0.86		0.51		0.69	
ANALYST REL DEV, %	29.24		28.40		13.17		23.16		14.51		19.90	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	16	16	14	14	15	14	13	14	11	12	15	15
TRUE CONC (C) UG/L	60.00	50.00	60.00	50.00	60.00	50.00	60.00	50.00	60.00	50.00	60.00	50.00
MEAN RECOVERY (X)	41.43	33.84	42.46	31.44	43.28	35.37	46.98	37.42	43.02	32.12	41.10	30.53
ACCURACY(%REL ERROR)	-30.95	-32.32	-29.24	-37.12	-27.86	-29.26	-21.70	-25.16	-28.31	-35.77	-31.51	-38.95
OVERALL STD DEV (S)	20.61	16.29	13.62	12.71	8.05	12.04	14.41	13.87	13.54	9.59	14.21	9.70
OVERALL REL STD DEV, %	49.75	48.15	32.08	40.42	18.60	34.03	30.68	37.07	31.49	29.86	34.59	31.76
SINGLE STD DEV, (SR)	9.99		11.66		8.66		5.96		6.84		14.48	
ANALYST REL DEV, %	26.54		31.55		22.03		14.11		18.20		40.43	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	16	16	14	14	15	14	13	13	12	10	15	15
TRUE CONC (C) UG/L	205.00	280.00	205.00	280.00	205.00	280.00	205.00	280.00	205.00	280.00	205.00	280.00
MEAN RECOVERY (X)	158.61	199.17	146.86	207.43	126.73	204.81	167.89	213.19	163.83	203.43	141.03	216.25
ACCURACY(%REL ERROR)	-22.63	-28.87	-28.36	-25.92	-38.18	-26.85	-18.10	-23.86	-20.08	-27.35	-31.20	-22.77
OVERALL STD DEV (S)	65.07	93.58	51.44	74.71	64.93	84.06	31.73	34.82	41.05	49.56	55.95	97.18
OVERALL REL STD DEV, %	41.02	46.98	35.02	36.02	51.24	41.04	18.90	16.33	25.05	24.36	39.67	44.94
SINGLE STD DEV, (SR)	51.09		36.62		37.37		16.94		23.60		51.01	
ANALYST REL DEV, %	28.56		20.67		22.54		8.89		12.85		28.55	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 9. STATISTICAL SUMMARY OF ANTHRACENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	13	13	13	12	13	10	13	13	13	13	14	13
TRUE CONC (C) UG/L	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00
MEAN RECOVERY (X)	5.13	7.54	4.36	6.75	6.13	8.00	6.91	8.89	6.00	8.66	6.56	9.47
ACCURACY(%REL ERROR)	-48.67	-46.16	-56.45	-51.82	-38.74	-42.82	-30.85	-36.49	-39.97	-38.15	-34.36	-32.35
OVERALL STD DEV (S)	2.32	4.11	2.00	2.64	1.64	1.83	2.28	3.00	1.56	2.87	1.94	1.41
OVERALL REL STD DEV, %	45.25	54.51	45.96	39.12	26.82	22.88	32.95	33.78	26.04	33.15	29.53	14.88
SINGLE STD DEV, (SR)	2.63		1.86		1.59		2.50		1.49		1.53	
ANALYST REL DEV, %	41.54		33.44		22.56		31.69		20.34		19.13	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	13	13	13	13	13	12	13	13	13	13	14	14
TRUE CONC (C) UG/L	70.00	85.00	70.00	85.00	70.00	85.00	70.00	85.00	70.00	85.00	70.00	85.00
MEAN RECOVERY (X)	41.70	48.63	41.89	49.35	44.06	58.48	53.74	55.88	46.54	47.99	49.10	52.33
ACCURACY(%REL ERROR)	-40.43	-42.79	-40.16	-41.94	-37.06	-31.20	-23.23	-34.26	-33.52	-43.54	-29.85	-38.43
OVERALL STD DEV (S)	17.52	20.67	16.29	18.22	11.81	10.33	17.70	22.82	12.30	18.09	11.59	21.72
OVERALL REL STD DEV, %	42.00	42.51	38.88	36.91	26.80	17.66	32.95	40.84	26.43	37.70	23.59	41.51
SINGLE STD DEV, (SR)	9.08		10.37		6.35		10.40		9.25		15.09	
ANALYST REL DEV, %	20.10		22.74		12.38		18.97		19.58		29.75	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	13	13	13	13	12	13	13	13	13	12	14	13
TRUE CONC (C) UG/L	400.00	350.00	400.00	350.00	400.00	350.00	400.00	350.00	400.00	350.00	400.00	350.00
MEAN RECOVERY (X)	256.47	235.14	253.90	228.92	243.58	220.02	289.69	223.00	258.05	230.15	263.35	230.45
ACCURACY(%REL ERROR)	-35.88	-32.82	-36.52	-34.59	-39.10	-37.14	-27.58	-36.29	-35.49	-34.24	-34.16	-34.16
OVERALL STD DEV (S)	108.92	90.61	109.85	105.28	109.70	93.52	133.06	72.08	86.88	75.53	107.19	80.41
OVERALL REL STD DEV, %	42.47	38.54	43.26	45.99	45.03	42.51	45.93	32.32	33.67	32.82	40.70	34.89
SINGLE STD DEV, (SR)	67.63		56.77		57.42		53.43		45.97		43.41	
ANALYST REL DEV, %	27.51		23.52		24.77		20.84		18.83		17.58	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 10. STATISTICAL SUMMARY OF FLUORANTHENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	11	11	10	9	11	9	13	12	11	11	13	13
TRUE CONC (C) UG/L	0.30	0.40	0.30	0.40	0.30	0.40	0.30	0.40	0.30	0.40	0.30	0.40
MEAN RECOVERY (X)	0.30	0.29	0.18	0.27	0.23	0.28	0.21	0.32	0.23	0.32	0.25	0.30
ACCURACY(%REL ERROR)	1.07	-28.59	-39.37	-32.75	-24.24	-29.72	-28.59	-20.60	-24.97	-19.70	-16.56	-26.02
OVERALL STD DEV (S)	0.16	0.10	0.08	0.09	0.09	0.13	0.05	0.13	0.08	0.12	0.13	0.14
OVERALL REL STD DEV, %	51.51	35.07	42.06	34.15	39.20	45.62	25.16	40.69	36.70	36.82	53.55	45.97
SINGLE STD DEV, (SR)	0.13		0.06		0.03		0.07		0.04		0.06	
ANALYST REL DEV, %	43.41		27.61		12.91		24.78		14.27		20.80	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	12	12	12	12	12	12	13	12	13	13	12	14
TRUE CONC (C) UG/L	4.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00
MEAN RECOVERY (X)	2.64	1.87	2.81	2.09	2.56	1.82	2.82	2.31	2.92	1.85	2.94	1.86
ACCURACY(%REL ERROR)	-33.92	-37.62	-29.85	-30.39	-36.10	-39.42	-29.50	-23.06	-26.92	-38.41	-26.50	-37.83
OVERALL STD DEV (S)	0.83	0.79	0.78	0.85	0.87	0.78	1.04	0.89	0.77	0.63	0.44	0.79
OVERALL REL STD DEV, %	31.27	42.30	27.82	40.75	33.99	42.77	36.96	38.65	26.49	34.21	15.08	42.55
SINGLE STD DEV, (SR)	0.50		0.69		0.31		0.25		0.47		0.49	
ANALYST REL DEV, %	22.18		28.03		14.28		9.60		19.60		20.36	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	11	11	12	10	12	11	13	12	12	10	13	11
TRUE CONC (C) UG/L	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00
MEAN RECOVERY (X)	10.93	9.19	10.51	8.65	8.43	7.07	10.74	9.50	10.70	9.07	13.82	8.85
ACCURACY(%REL ERROR)	-27.16	-23.44	-29.96	-27.92	-43.82	-41.08	-28.39	-20.86	-28.67	-24.38	-7.90	-26.23
OVERALL STD DEV (S)	3.05	2.73	3.50	2.68	4.32	3.35	3.27	3.05	3.66	2.13	9.61	2.29
OVERALL REL STD DEV, %	27.95	29.69	33.31	30.94	51.30	47.40	30.42	32.07	34.24	23.52	69.56	25.91
SINGLE STD DEV, (SR)	2.50		1.89		2.82		1.62		1.44		6.16	
ANALYST REL DEV, %	24.84		19.74		36.44		16.04		14.60		54.34	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 11. STATISTICAL SUMMARY OF PYRENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	13	14	11	12	13	11	11	12	12	11	12	12
TRUE CONC (C) UG/L	2.00	2.60	2.00	2.60	2.00	2.60	2.00	2.60	2.00	2.60	2.00	2.60
MEAN RECOVERY (X)	1.35	1.53	1.45	1.86	1.51	1.68	1.37	2.01	1.55	1.99	1.53	2.06
ACCURACY(%REL ERROR)	-32.51	-41.33	-27.73	-28.62	-24.35	-35.24	-31.38	-22.85	-22.25	-23.50	-23.65	-20.80
OVERALL STD DEV (S)	0.44	0.77	0.68	0.77	0.50	0.19	0.34	0.48	0.27	0.57	0.53	0.61
OVERALL REL STD DEV, %	32.84	50.34	47.15	41.40	33.12	11.28	24.69	23.81	17.21	28.56	35.03	29.73
SINGLE STD DEV, (SR)	0.50		0.44		0.26		0.44		0.43		0.35	
ANALYST REL DEV, %	34.54		26.48		16.22		26.20		24.42		19.78	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	16	16	15	14	13	14	13	13	14	14	13	14
TRUE CONC (C) UG/L	24.00	28.00	24.00	28.00	24.00	28.00	24.00	28.00	24.00	28.00	24.00	28.00
MEAN RECOVERY (X)	14.46	16.83	16.37	18.15	17.62	21.71	17.87	19.75	14.31	16.48	17.83	19.62
ACCURACY(%REL ERROR)	-39.74	-39.88	-31.77	-35.18	-26.60	-22.45	-25.54	-29.46	-40.36	-41.16	-25.70	-29.92
OVERALL STD DEV (S)	7.43	7.34	5.71	6.98	4.61	6.33	5.58	6.39	6.42	5.93	4.34	5.80
OVERALL REL STD DEV, %	51.36	43.60	34.88	38.47	26.19	29.16	31.23	32.34	44.85	36.00	24.36	29.54
SINGLE STD DEV, (SR)	3.45		4.25		3.25		3.28		5.15		4.25	
ANALYST REL DEV, %	22.06		24.63		16.55		17.42		33.44		22.69	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	15	16	15	14	14	13	13	12	13	12	12	14
TRUE CONC (C) UG/L	90.00	75.00	90.00	75.00	90.00	75.00	90.00	75.00	90.00	75.00	90.00	75.00
MEAN RECOVERY (X)	71.67	55.11	65.18	49.09	64.54	57.14	62.57	52.75	67.87	52.59	70.65	63.19
ACCURACY(%REL ERROR)	-20.37	-26.52	-27.58	-34.55	-28.29	-23.82	-30.48	-29.67	-24.59	-29.88	-21.50	-15.74
OVERALL STD DEV (S)	27.73	17.80	23.32	23.28	26.67	13.50	17.45	7.27	22.08	10.69	15.19	16.22
OVERALL REL STD DEV, %	38.69	32.30	35.78	47.43	41.32	23.62	27.88	13.78	32.53	20.33	21.50	25.66
SINGLE STD DEV, (SR)	17.72		14.99		16.36		10.67		12.73		11.70	
ANALYST REL DEV, %	27.95		26.24		26.88		18.51		21.13		17.48	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 12. STATISTICAL SUMMARY OF BENZO(a)ANTHRACENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	11	11	13	13	10	9	14	12	13	13	12	13
TRUE CONC (C) UG/L	0.50	0.60	0.50	0.60	0.50	0.60	0.50	0.60	0.50	0.60	0.50	0.60
MEAN RECOVERY (X)	0.43	0.48	0.49	0.42	0.38	0.40	0.54	0.47	0.37	0.47	0.39	0.44
ACCURACY(%REL ERROR)	-14.82	-19.47	-2.17	-29.27	-24.56	-33.04	8.70	-22.44	-26.43	-21.55	-22.12	-25.92
OVERALL STD DEV (S)	0.16	0.20	0.29	0.17	0.12	0.05	0.30	0.16	0.12	0.17	0.19	0.16
OVERALL REL STD DEV, %	37.79	41.84	59.24	40.26	31.42	12.78	54.77	33.84	33.32	36.27	47.57	35.17
SINGLE STD DEV, (SR)	0.17		0.24		0.06		0.15		0.07		0.08	
ANALYST REL DEV, %	38.11		52.49		16.29		30.27		17.65		18.31	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	11	11	13	13	11	12	13	13	13	13	13	14
TRUE CONC (C) UG/L	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00
MEAN RECOVERY (X)	3.88	3.46	4.56	3.88	4.38	4.11	4.15	4.35	3.97	2.87	4.71	3.86
ACCURACY(%REL ERROR)	-35.30	-30.87	-23.94	-22.37	-27.02	-17.77	-30.79	-13.03	-33.82	-42.66	-21.49	-22.79
OVERALL STD DEV (S)	1.02	1.01	1.92	1.99	1.15	1.25	1.55	1.46	1.74	1.11	1.57	1.54
OVERALL REL STD DEV, %	26.21	29.24	42.09	51.34	26.29	30.31	37.39	33.47	43.89	38.66	33.26	39.85
SINGLE STD DEV, (SR)	0.91		1.10		0.38		1.02		0.95		0.80	
ANALYST REL DEV, %	24.75		25.98		9.05		23.99		27.92		18.56	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	12	12	13	13	12	11	13	12	14	13	14	13
TRUE CONC (C) UG/L	12.00	16.00	12.00	16.00	12.00	16.00	12.00	16.00	12.00	16.00	12.00	16.00
MEAN RECOVERY (X)	9.86	12.38	10.11	11.74	9.42	11.29	8.56	11.87	9.88	11.34	9.34	11.40
ACCURACY(%REL ERROR)	-17.82	-22.59	-15.76	-26.62	-21.49	-29.42	-28.65	-25.83	-17.68	-29.12	-22.16	-28.75
OVERALL STD DEV (S)	5.27	3.47	2.49	4.12	3.26	4.64	3.04	2.91	4.55	4.65	3.55	2.30
OVERALL REL STD DEV, %	53.49	27.98	24.65	35.12	34.62	41.05	35.51	24.54	46.10	41.00	38.06	20.18
SINGLE STD DEV, (SR)	3.68		2.69		2.65		2.50		2.86		1.81	
ANALYST REL DEV, %	33.05		24.67		25.56		24.44		26.93		17.45	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 13. STATISTICAL SUMMARY OF CHRYSENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	11	12	12	13	11	11	11	12	13	13	14	14
TRUE CONC (C) UG/L	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00
MEAN RECOVERY (X)	1.32	2.26	1.63	2.21	2.00	2.58	1.57	2.90	1.89	3.06	2.03	2.77
ACCURACY(%REL ERROR)	-33.80	-24.54	-18.45	-26.31	-0.13	-13.85	-21.64	-3.33	-5.35	1.95	1.46	-7.69
OVERALL STD DEV (S)	0.48	1.21	0.80	1.10	0.92	0.95	0.59	1.24	1.08	1.32	1.02	1.43
OVERALL REL STD DEV, %	35.94	53.24	49.26	49.59	46.01	36.73	37.52	42.78	57.06	43.22	50.35	51.58
SINGLE STD DEV, (SR)	0.41		0.41		0.41		0.58		1.07		0.60	
ANALYST REL DEV, %	22.64		21.13		17.74		26.08		43.12		25.22	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	12	12	12	12	14	13	13	11	14	13	14	14
TRUE CONC (C) UG/L	20.00	28.00	20.00	28.00	20.00	28.00	20.00	28.00	20.00	28.00	20.00	28.00
MEAN RECOVERY (X)	15.00	19.50	15.13	19.71	15.43	21.04	16.91	23.50	26.12	29.22	22.65	24.97
ACCURACY(%REL ERROR)	-24.97	-30.34	-24.36	-29.62	-22.86	-24.84	-15.46	-16.06	30.60	4.37	13.26	-10.83
OVERALL STD DEV (S)	8.21	11.03	7.48	10.67	6.56	7.92	7.00	8.23	13.52	14.60	12.00	11.14
OVERALL REL STD DEV, %	54.71	56.55	49.46	54.15	42.49	37.66	41.43	35.03	51.75	49.97	52.96	44.62
SINGLE STD DEV, (SR)	3.45		4.62		3.71		5.52		4.42		5.69	
ANALYST REL DEV, %	19.99		26.54		20.37		27.32		15.96		23.91	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	13	13	13	13	14	14	14	14	14	13	15	14
TRUE CONC (C) UG/L	60.00	40.00	60.00	40.00	60.00	40.00	60.00	40.00	60.00	40.00	60.00	40.00
MEAN RECOVERY (X)	48.10	32.14	60.09	32.38	50.10	31.76	56.03	47.93	75.40	48.38	59.21	42.13
ACCURACY(%REL ERROR)	-19.83	-19.66	0.15	-19.04	-16.51	-20.61	-6.62	19.82	25.67	20.96	-1.32	5.32
OVERALL STD DEV (S)	27.74	15.70	32.40	19.44	29.98	18.65	21.84	27.52	34.38	22.74	28.21	15.41
OVERALL REL STD DEV, %	57.67	48.84	53.92	60.03	59.85	58.72	38.98	57.43	45.60	47.00	47.66	36.57
SINGLE STD DEV, (SR)	16.78		22.70		21.28		15.25		22.64		12.47	
ANALYST REL DEV, %	41.82		49.10		52.01		29.34		36.58		24.61	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 14. STATISTICAL SUMMARY OF BENZO(b)FLUORANTHENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	11	11	12	13	13	13	13	14	12	12	13	12
TRUE CONC (C) UG/L	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30
MEAN RECOVERY (X)	0.17	0.25	0.18	0.23	0.17	0.20	0.15	0.23	0.20	0.24	0.20	0.23
ACCURACY(%REL ERROR)	-16.45	-17.42	-10.96	-21.67	-15.37	-34.28	-23.65	-24.43	-2.21	-20.08	-0.69	-23.06
OVERALL STD DEV (S)	0.07	0.08	0.06	0.05	0.06	0.06	0.04	0.05	0.06	0.07	0.09	0.05
OVERALL REL STD DEV, %	39.73	31.71	31.85	20.09	35.13	30.95	28.89	21.71	31.57	30.18	44.74	20.56
SINGLE STD DEV, (SR)	0.06		0.05		0.04		0.04		0.06		0.04	
ANALYST REL DEV, %	28.00		22.05		19.11		19.44		25.54		20.85	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	12	13	13	12	15	14	15	13	13	14	14	14
TRUE CONC (C) UG/L	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00
MEAN RECOVERY (X)	2.24	1.48	2.41	1.64	2.22	1.47	2.03	1.81	2.41	1.69	2.58	1.84
ACCURACY(%REL ERROR)	-25.17	-25.89	-19.81	-18.04	-25.86	-26.28	-32.22	-9.32	-19.51	-15.66	-14.10	-8.00
OVERALL STD DEV (S)	0.73	0.62	0.91	0.65	0.89	0.47	0.70	0.76	0.48	0.76	0.79	0.72
OVERALL REL STD DEV, %	32.48	41.64	38.01	39.70	40.10	31.77	34.62	41.74	20.02	44.93	30.70	39.33
SINGLE STD DEV, (SR)	0.39		0.51		0.29		0.30		0.42		0.62	
ANALYST REL DEV, %	20.99		24.99		15.59		15.85		20.38		28.10	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	13	13	12	13	15	15	15	15	14	12	14	14
TRUE CONC (C) UQ/L	8.00	11.00	8.00	11.00	8.00	11.00	8.00	11.00	8.00	11.00	8.00	11.00
MEAN RECOVERY (X)	7.14	8.26	6.99	9.47	5.98	8.30	6.27	9.30	8.74	9.94	7.21	10.49
ACCURACY(%REL ERROR)	-10.73	-24.92	-12.56	-13.89	-25.25	-24.54	-21.57	-15.45	9.20	-9.66	-9.91	-4.64
OVERALL STD DEV (S)	2.85	3.30	2.02	2.19	3.18	4.99	2.35	3.85	4.69	4.39	3.12	3.85
OVERALL REL STD DEV, %	39.98	39.92	28.86	23.17	53.16	60.08	37.50	41.41	53.67	44.16	43.22	36.69
SINGLE STD DEV, (SR)	1.74		1.82		2.51		1.97		3.18		2.03	
ANALYST REL DEV, %	22.62		22.09		35.22		25.30		34.04		22.96	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 15. STATISTICAL SUMMARY OF BENZO(k)FLUORANTHENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	12	11	12	12	11	12	11	9	9	13	10	9
TRUE CONC (C) UG/L	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15
MEAN RECOVERY (X)	0.07	0.10	0.06	0.17	0.11	0.27	0.12	0.10	0.08	0.30	0.07	0.10
ACCURACY(%REL ERROR)	-40.83	-33.70	-49.53	10.83	-7.65	83.22	-3.41	-34.67	-33.96	103.09	-39.08	-35.94
OVERALL STD DEV (S)	0.06	0.07	0.04	0.18	0.08	0.32	0.11	0.03	0.03	0.30	0.03	0.03
OVERALL REL STD DEV, %	85.19	66.92	63.59	107.47	74.74	115.71	93.85	27.27	43.78	99.02	41.25	27.33
SINGLE STD DEV, (SR)	0.03		0.11		0.20		0.01		0.02		0.02	
ANALYST REL DEV, %	36.33		95.60		101.91		11.72		11.81		20.11	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	12	12	13	14	13	13	10	10	12	13	11	13
TRUE CONC (C) UG/L	1.40	1.10	1.40	1.10	1.40	1.10	1.40	1.10	1.40	1.10	1.40	1.10
MEAN RECOVERY (X)	0.97	0.56	1.04	1.25	1.79	1.26	0.76	0.65	1.85	1.29	1.22	1.18
ACCURACY(%REL ERROR)	-30.94	-49.22	-25.95	13.74	28.12	14.56	-46.00	-40.68	32.48	17.22	-12.51	7.46
OVERALL STD DEV (S)	0.63	0.42	0.66	1.28	1.32	0.93	0.30	0.28	1.30	0.83	0.63	1.01
OVERALL REL STD DEV, %	64.75	75.59	63.56	102.17	73.42	73.66	40.22	42.21	70.18	64.45	51.05	85.17
SINGLE STD DEV, (SR)	0.22		0.87		0.32		0.13		0.69		0.28	
ANALYST REL DEV, %	29.23		76.09		20.88		18.07		44.20		23.43	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	11	12	14	13	12	13	10	13	12	10	13	12
TRUE CONC (C) UG/L	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00
MEAN RECOVERY (X)	2.07	3.83	4.34	4.97	3.16	5.16	2.24	4.97	3.55	5.26	4.29	5.06
ACCURACY(%REL ERROR)	-48.36	-36.24	8.44	-17.21	-20.96	-14.03	-44.06	-17.13	-11.25	-12.30	7.35	-15.58
OVERALL STD DEV (S)	1.26	3.12	4.41	3.90	2.19	3.49	0.82	3.19	1.80	3.01	3.70	2.63
OVERALL REL STD DEV, %	60.89	81.65	101.73	78.57	69.34	67.73	36.53	64.21	50.77	57.21	86.22	51.91
SINGLE STD DEV, (SR)	1.64		1.30		1.25		0.61		1.89		0.99	
ANALYST REL DEV, %	55.53		28.02		30.05		16.83		42.90		21.22	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 16. STATISTICAL SUMMARY OF BENZO(a)PYRENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	13	12	13	13	15	15	14	14	13	14	13	12
TRUE CONC (C) UG/L	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30
MEAN RECOVERY (X)	0.12	0.18	0.09	0.14	0.14	0.20	0.15	0.23	0.14	0.21	0.15	0.21
ACCURACY(%REL ERROR)	-40.15	-40.94	-53.81	-53.96	-27.85	-33.09	-25.79	-24.62	-31.40	-29.62	-22.86	-31.08
OVERALL STD DEV (S)	0.05	0.07	0.05	0.06	0.07	0.09	0.05	0.09	0.04	0.11	0.06	0.04
OVERALL REL STD DEV, %	44.51	40.96	55.95	43.69	49.03	42.60	34.50	39.68	30.94	51.18	38.91	20.11
SINGLE STD DEV, (SR)	0.05		0.03		0.04		0.04		0.06		0.03	
ANALYST REL DEV, %	34.60		23.93		21.53		23.49		33.90		19.33	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	13	14	14	14	15	16	15	14	15	14	14	15
TRUE CONC (C) UG/L	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
MEAN RECOVERY (X)	1.35	1.53	0.96	1.38	1.38	1.90	1.27	2.09	1.52	1.80	1.58	2.06
ACCURACY(%REL ERROR)	-32.64	-45.51	-51.89	-50.71	-31.08	-32.28	-36.40	-25.43	-24.20	-35.66	-21.03	-26.54
OVERALL STD DEV (S)	0.67	0.77	0.49	0.75	0.49	0.85	0.54	0.98	0.34	0.73	0.44	0.85
OVERALL REL STD DEV, %	49.70	50.24	50.49	54.04	35.23	44.64	42.34	47.00	22.57	40.39	27.91	41.23
SINGLE STD DEV, (SR)	0.44		0.34		0.20		0.71		0.53		0.40	
ANALYST REL DEV, %	30.61		28.63		12.24		42.24		32.22		22.01	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	14	14	15	15	16	16	15	15	15	12	15	15
TRUE CONC (C) UG/L	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00
MEAN RECOVERY (X)	6.43	7.35	7.16	8.51	7.32	9.75	7.71	9.88	9.28	10.54	7.67	10.32
ACCURACY(%REL ERROR)	-46.45	-50.98	-40.37	-43.25	-39.02	-34.99	-35.73	-34.14	-22.66	-29.72	-36.11	-31.22
OVERALL STD DEV (S)	3.57	4.02	4.06	4.37	3.93	5.13	3.10	4.50	4.78	4.25	3.98	4.53
OVERALL REL STD DEV, %	55.59	54.69	56.68	51.32	53.75	52.60	40.21	45.53	51.52	40.29	51.95	43.91
SINGLE STD DEV, (SR)	3.01		2.23		2.88		1.66		2.99		1.62	
ANALYST REL DEV, %	43.71		28.43		33.74		18.90		30.16		18.02	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 17. STATISTICAL SUMMARY OF DIBENZO(a,h)ANTHRACENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	11	12	12	11	12	13	11	11	11	11	14	13
TRUE CONC (C) UG/L	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70
MEAN RECOVERY (X)	0.27	0.48	0.48	0.46	0.29	0.53	0.30	0.46	0.35	0.66	0.48	0.73
ACCURACY(%REL ERROR)	-46.49	-30.83	-3.23	-34.32	-41.58	-24.91	-39.00	-34.51	-29.55	-5.70	-3.69	4.27
OVERALL STD DEV (S)	0.14	0.27	0.31	0.18	0.11	0.27	0.10	0.18	0.12	0.31	0.27	0.46
OVERALL REL STD DEV, %	51.30	54.82	63.25	39.39	38.06	51.70	31.59	39.32	33.69	46.79	55.97	63.68
SINGLE STD DEV, (SR)	0.11		0.19		0.18		0.09		0.24		0.14	
ANALYST REL DEV, %	28.57		39.56		43.55		24.80		48.28		23.65	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	13	14	13	12	13	14	14	13	12	14	14	15
TRUE CONC (C) UG/L	6.50	5.00	6.50	5.00	6.50	5.00	6.50	5.00	6.50	5.00	6.50	5.00
MEAN RECOVERY (X)	2.60	1.85	3.97	2.87	5.02	3.63	4.53	3.44	4.57	3.36	4.89	3.08
ACCURACY(%REL ERROR)	-59.93	-62.97	-38.98	-42.50	-22.80	-27.47	-30.36	-31.17	-29.67	-32.84	-24.76	-38.40
OVERALL STD DEV (S)	1.10	0.99	2.55	0.97	2.10	2.02	2.18	1.32	1.16	2.00	2.43	1.32
OVERALL REL STD DEV, %	42.24	53.46	64.25	33.84	41.93	55.81	48.21	38.45	25.47	59.65	49.76	42.75
SINGLE STD DEV, (SR)	0.46		1.65		0.99		1.05		1.11		1.42	
ANALYST REL DEV, %	20.77		48.19		22.95		26.29		27.99		35.64	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	13	14	13	13	14	14	14	13	12	12	15	15
TRUE CONC (C) UG/L	24.00	20.00	24.00	20.00	24.00	20.00	24.00	20.00	24.00	20.00	24.00	20.00
MEAN RECOVERY (X)	9.85	9.24	19.79	15.35	14.80	13.66	16.81	14.90	21.76	14.82	16.52	16.54
ACCURACY(%REL ERROR)	-58.95	-53.78	-17.56	-23.24	-38.32	-31.71	-29.97	-25.50	-9.32	-25.89	-31.18	-17.30
OVERALL STD DEV (S)	4.39	3.72	10.01	4.31	8.55	5.18	5.77	2.56	7.78	4.88	7.40	7.40
OVERALL REL STD DEV, %	44.57	40.25	50.58	28.07	57.79	37.90	34.34	17.17	35.73	32.92	44.81	44.76
SINGLE STD DEV, (SR)	2.57		6.40		6.39		3.43		4.66		5.53	
ANALYST REL DEV, %	26.89		36.43		44.94		21.66		25.49		33.46	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 18. STATISTICAL SUMMARY OF BENZO(g,h,i)PERYLENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	13	13	10	11	15	14	11	11	11	11	12	12
TRUE CONC (C) UG/L	1.00	1.40	1.00	1.40	1.00	1.40	1.00	1.40	1.00	1.40	1.00	1.40
MEAN RECOVERY (X)	0.73	0.93	0.66	0.89	0.82	0.80	0.66	0.98	0.85	1.14	0.90	1.18
ACCURACY(%REL ERROR)	-26.88	-33.28	-33.81	-36.75	-18.37	-43.11	-33.96	-29.82	-15.35	-18.57	-10.28	-16.03
OVERALL STD DEV (S)	0.60	0.55	0.20	0.24	0.48	0.26	0.17	0.23	0.27	0.30	0.44	0.31
OVERALL REL STD DEV, %	82.01	59.13	30.16	26.62	58.88	32.72	25.94	23.86	32.16	26.46	49.48	26.31
SINGLE STD DEV, (SR)	0.25		0.13		0.18		0.17		0.28		0.18	
ANALYST REL DEV, %	29.79		16.28		22.50		20.29		28.32		17.29	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	14	14	11	10	14	15	12	10	12	13	13	13
TRUE CONC (C) UG/L	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00
MEAN RECOVERY (X)	5.58	4.36	10.00	6.18	9.61	6.47	10.06	7.13	9.85	6.97	9.23	6.41
ACCURACY(%REL ERROR)	-60.12	-56.35	-28.55	-38.23	-31.33	-35.34	-28.17	-28.69	-29.62	-30.26	-34.06	-35.89
OVERALL STD DEV (S)	2.68	2.40	3.54	2.33	5.10	3.28	3.81	2.53	3.67	3.42	3.44	2.15
OVERALL REL STD DEV, %	48.06	54.95	35.37	37.80	53.07	50.74	37.93	35.49	37.29	49.01	37.22	33.60
SINGLE STD DEV, (SR)	1.14		2.03		1.45		1.60		2.13		2.31	
ANALYST REL DEV, %	22.88		25.06		18.07		18.68		25.32		29.50	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	14	14	9	11	16	16	12	12	13	11	13	14
TRUE CONC (C) UG/L	35.00	50.00	35.00	50.00	35.00	50.00	35.00	50.00	35.00	50.00	35.00	50.00
MEAN RECOVERY (X)	19.52	20.33	25.07	39.05	21.79	38.34	23.65	38.67	28.90	32.28	23.76	41.46
ACCURACY(%REL ERROR)	-44.23	-59.33	-28.38	-21.89	-37.75	-23.32	-32.43	-22.67	-17.42	-35.43	-32.13	-17.08
OVERALL STD DEV (S)	14.17	12.75	3.59	12.05	12.91	27.03	7.33	14.66	15.88	14.96	10.35	22.91
OVERALL REL STD DEV, %	72.59	62.71	14.31	30.84	59.26	70.50	31.01	37.92	54.96	46.35	43.58	55.27
SINGLE STD DEV, (SR)	5.37		7.05		17.62		9.50		8.92		11.39	
ANALYST REL DEV, %	26.93		21.99		58.61		30.49		29.14		34.92	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 19. STATISTICAL SUMMARY OF INDENO(1,2,3-cd)PYRENE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4		WATER 5		WATER 6	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	12	13	11	12	13	14	12	13	11	11	10	11
TRUE CONC (C) UG/L	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00
MEAN RECOVERY (X)	0.40	0.70	0.43	0.74	0.44	0.69	0.47	0.77	0.62	1.03	0.48	0.80
ACCURACY(%REL ERROR)	-46.99	-30.22	-42.11	-25.83	-41.22	-31.41	-37.74	-23.25	-17.88	2.91	-36.52	-19.69
OVERALL STD DEV (S)	0.16	0.35	0.17	0.36	0.13	0.26	0.17	0.28	0.31	0.73	0.15	0.34
OVERALL REL STD DEV, %	40.34	49.92	38.29	48.01	28.91	37.83	35.77	36.16	50.24	71.31	31.93	42.83
SINGLE STD DEV, (SR)	0.19		0.15		0.12		0.10		0.33		0.17	
ANALYST REL DEV, %	34.31		25.95		21.19		16.76		40.41		26.82	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	13	12	11	11	13	13	13	12	10	12	12	12
TRUE CONC (C) UG/L	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00
MEAN RECOVERY (X)	3.05	3.11	3.49	3.95	3.33	3.52	3.09	3.50	4.32	5.24	4.25	3.93
ACCURACY(%REL ERROR)	-39.03	-48.21	-30.17	-34.12	-33.34	-41.37	-38.11	-41.74	-13.64	-12.71	-14.90	-34.47
OVERALL STD DEV (S)	1.66	1.31	1.74	1.68	1.22	0.91	0.98	1.21	1.10	2.81	1.80	1.29
OVERALL REL STD DEV, %	54.40	42.17	49.85	42.42	36.72	25.94	31.68	34.63	25.44	53.64	42.28	32.83
SINGLE STD DEV, (SR)	0.59		1.30		0.40		0.49		0.93		1.27	
ANALYST REL DEV, %	19.21		34.95		11.60		14.77		19.37		31.11	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	12	11	11	11	13	13	14	14	12	10	12	13
TRUE CONC (C) UG/L	22.00	15.00	22.00	15.00	22.00	15.00	22.00	15.00	22.00	15.00	22.00	15.00
MEAN RECOVERY (X)	10.66	8.11	15.56	10.45	12.39	9.01	14.16	12.00	26.39	12.08	16.03	15.06
ACCURACY(%REL ERROR)	-51.53	-45.92	-29.25	-30.32	-43.67	-39.92	-35.63	-20.01	19.95	-19.48	-27.15	0.39
OVERALL STD DEV (S)	5.53	1.41	6.46	1.90	6.41	4.32	5.81	6.74	17.67	5.71	5.99	8.43
OVERALL REL STD DEV, %	51.82	17.38	41.53	18.14	51.72	47.97	41.04	56.17	66.94	47.26	37.37	55.99
SINGLE STD DEV, (SR)	3.56		3.86		4.16		4.09		10.77		6.17	
ANALYST REL DEV, %	37.89		29.67		38.89		31.29		56.00		39.70	

WATER LEGEND

1 - DISTILLED WATER
2 - TAP WATER
3 - SURFACE WATER
4 - WASTEWATER (C-94)
5 - WASTEWATER (C-95)
6 - WASTEWATER (C-96)

TABLE 20. SUMMARY OF THE TESTS FOR THE DIFFERENCES ACROSS WATER TYPES

Compound	Observed F-Value	P[F>F OBS]	F-Test Statistically Significant at the 5% Level?	Significance Effect Established by the 95% Confidence Intervals?	Water Type Showing Effect	Practical Significance Established
Naphtalene	2.18	0.02	Yes	No		No
Acenaphthylene	2.80	0.00	Yes	Yes	4	Yes
Acenaphthene	1.94	0.04	Yes	No		No
Fluorene	0.54	0.86	No	No		No
Phenanthrene	2.00	0.03	Yes	No		No
Anthracene	3.25	0.00	Yes	Yes	3,4,6	Yes
Fluoranthene	2.28	0.01	Yes	No		No
Pyrene	1.78	0.06	No	No		No
Benzo(a)anthracene	0.72	0.71	No	No		No
Chrysene	4.36	0.00	Yes	No		No
Benzo(b)fluoranthene	2.25	0.02	Yes	No		No
Benzo(k)fluoranthene	3.76	0.00	Yes	Yes	3,5,6	Yes
Benzo(a)pyrene	4.50	0.00	Yes	No		No
Dibenzo(a,h)anthracene	8.90	0.00	Yes	Yes	5,6	Yes
Benzo(g,h,i)perylene	7.92	0.00	Yes	Yes	2,5	Yes
Indeno(1,2,3-cd)pyrene	6.00	0.00	Yes	Yes	5	Yes

For six of the sixteen PNA compounds, a statistically significant effect due to water type was established since the $P[F>F\ OBS] \leq 0.05$ and zero was contained within the 95 percent confidence interval for a specific water type. As indicated in Section 4, the multiplicative model is a statistical screening procedure and a detailed study of the regression equations, the statistical summary, and raw data must be conducted to determine if there is any effect of practical importance. The results of the examination of the data for the 6 PNA compounds are summarized below:

A. Acenaphthylene - Wastewater C-94 was the only water type to show statistical significence (intercept). Comparison of the percent recoveries in Table 21 shows 68 and 83 for distilled and C-94 Wastewater, respectively. As indicated previously, this difference is due largely to the fact that all analysts analyzed the distilled water samples first, and with added experience, become more proficient with Wastewater C-94 (learning experience). This conclusion is further reinforced by comparing the overall percent RSD of distilled (42) and C-94 (32) and single-analyst percent RSD of distilled (36) and C-95 (20), in Tables 22 and 23, respectively. Therefore, it was judged that the statistical effect was of no practical importance.

B. Anthracene - Surface, and Wastewaters C-94 and C-96 indicated a statistically significant effect (intercepts). Comparison of the percentage recovery shows distilled water (50 percent) significantly lower than these water types ($\sim$60 percent). Comparison of the summary statistics for the low Youden pair show poorer recovery and larger overall and single-analyst percent RSD for distilled water. Significantly lower recovery was also experienced at the middle Youden pair. Due to the learning experience previously mentioned, it is judged that the statistical significance is of no practical importance for these water types.

C. Benzo(k)fluoranthene - Surface, and Wastewaters C-95 and C-96 were the water types that indicated statistical significance. Examination of the percentage recoveries in Table 21 show that the recovery of 59 percent for this PNA in distilled water is much lower than for surface water (103 percent), C-95 (110 percent) and C-96 (97 percent). This was attributed to the learning experience previously mentioned. Therefore, it was judged that the statistical significance was of no practical importance.

D. Dibenzo(a,h)anthracene, benzo(g,h,i)perylene, and indeno-(1,2,3-c,d)pyrene all show the same phenomenon of low recoveries from distilled water which is attributed to the learning effect. Therefore, it was concluded that the observed statistical effects for these 3 PNA's were of no practical importance.

A significant factor in the results obtained in this study is the relative inexperience most of the analysts had in HPLC analysis. While gas chromatography is widely used in commercial analytical laboratories conducting environmental analysis, HPLC is used only to a limited extent. The lack of HPLC experience, coupled with limited experience in conducting Method 610 probably contributed to the poorer recovery and precision encountered in the round robin study compared to the previous single laboratory evaluation.

GENERAL DISCUSSION OF METHOD PERFORMANCE

The percentage recovery, overall percent RSD, and single-analyst percent RSD are shown in Tables 21-23. These values were calculated by inserting specific analyte concentrations into the respective regression equations. For comparison, the specific values chosen were the average of the concentration range that BCL studied during the development of Method 610(8). This interpretative approach has been taken due to the non-zero intercepts in

TABLE 21. PERCENT RECOVERY FOR VARIOUS WATER TYPES

Compound	Concentrations** μg/L	Percent Recovery in Given Water Types(a)						Average Recovery For All Water Types	BCL Recovery Data(b)
					Wastewater				
		Distilled	Tap	Surface	C-94	C-95	C-96		
Naphthalene(c)	45	55	59	58	64	60	63	60	78
Acenaphthylene(c)	350	68	70	73	83*	75	82	75	93
Acenaphthene(c)	25	54	45	51	57	58	62	55	88
Fluorene(c)	14	52	50	55	60	58	57	55	90
Phenanthrene	4.5	51	55	64	65	62	60	60	98
Anthracene	10	50	43	60*	66*	61	67*	58	93
Fluoranthene	1.5	73	69	62	75	71	76	71	116
Pyrene	4.5	66	70	72	71	72	77	71	96
Benzo(a)anthracene	0.6	81	85	93	93	74	76	84	89
Chrysene	4.0	73	80	87	90	108	99	90	88
Benzo(b)fluoranthene	0.3	81	83	76	77	90	90	83	97
Benzo(k)fluoranthene	3.0	59	97	103*	62	110*	97*	88	94
Benzo(a)pyrene	0.3	59	47	68	74	69	73	65	94
Dibenzo(a,h)anthracene	1.0	52	77	68	66	79*	87*	72	87
Benzo(g,h,i)perylene	2.0	59	68*	70	70	78*	79	71	86
Indeno(1,2,3-cd)pyrene	1.0	60	65	62	68	90*	72	70	94

(a) Percent recovery is defined as $100\frac{(bx + a)}{X}$ where b and a are the slope and intercept, respectively, in the regression equation Y = bx + a; Y = mean recovery and X = true concentration.

(b) Data obtained during method development study, see reference (8).

(c) Laboratories were instructed to determine these PNA compounds using UV detection and the remaining compounds using fluorescence detection.

* Recovery for waters which indicated statistically significant matrix effects.

** The specific analyte concentration inserted into the regression equation and approximates the average concentration used by BCL to obtain recovery data during method development.

TABLE 22. OVERALL PERCENT RELATIVE STANDARD DEVIATION FOR VARIOUS WATER TYPES

Compound	Overall Percent RSD[a] in Given Water Types						Average For All Water Types
				Wastewater			
	Distilled	Tap	Surface	C-94	C-95	C-96	
Naphthalene	44	42	45	37	28	40	39
Acenaphthylene	42	44	30	32*	36	23	34
Acenaphthene	63	51	50	49	48	40	50
Fluorene	29	48	42	37	42	44	40
Phenanthrene	36	29	16	19	27	28	26
Anthracene	50	43	22*	33*	28	21*	33
Fluoranthene	35	33	43	34	31	41	36
Pyrene	42	42	26	25	28	29	33
Benzo(a)anthracene	38	47	23	43	34	41	38
Chrysene	48	52	44	42	50	49	48
Benzo(b)fluoranthene	38	28	61	30	35	33	38
Benzo(k)fluoranthene	70	91	76*	48	68*	68*	70
Benzo(a)pyrene	47	53	47	39	40	32	43
Dibenzo(a,h)anthracene	51	49	46	35	39*	54*	46
Benzo(g,h,i)perylene	66	29*	51	30	37*	39	42
Indeno(1,2,3-cd)pyrene	44	41	32	36	54*	37	41

(a) Overall percent relative standard deviation is defined as $100\frac{(bx + a)}{X}$ in the regression equation Y = bx + a, where X is mean recovery and Y is total interlaboratory standard deviation. Analyte concentrations inserted into the regression equation for overall RSD were the mean recoveries shown in Table 21.

* Recovery for waters which indicated statistically signficant matrix effects.

TABLE 23. SINGLE-ANALYST PERCENT RELATIVE STANDARD DEVIATION FOR VARIOUS WATER TYPES

	Single Analyst RSD(a) in Given Water Types						Average For All Water Types
				Wastewater			
Compound	Distilled	Tap	Surface	C-94	C-95	C-96	
Naphthalene	38	37	31	24	21	32	31
Acenaphthylene	36	38	27	20*	31	17	28
Acenaphthene	45	31	29	29	26	30	32
Fluorene	54	42	28	44	52	36	43
Phenanthrene	30	30	11	27	14	16	21
Anthracene	46	36	23*	34*	21	20*	30
Fluoranthene	28	24	23	15	16	35	24
Pyrene	30	26	19	22	26	20	24
Benzo(a)anthracene	36	48	16	29	19	18	28
Chrysene	26	28	24	27	35	25	28
Benzo(b)fluoranthene	30	24	22	21	24	22	24
Benzo(k)fluoranthene	43	50	24*	17	44*	22*	33
Benzo(a)pyrene	32	22	19	25	36	20	26
Dibenzo(a,h)anthracene	28	41	40	24	40*	28*	34
Benzo(g,h,i)perylene	28	20*	28	22	28*	23	25
Indeno(1,2,3-cd)pyrene	32	27	21	16	38*	27	27

(a) Single analyst percent relative standard deviation is defined as $100\frac{(dx + c)}{X}$ in the regression equation $Y = dx + c$, where X is mean recovery and Y is single-analyst standard deviation. Analyte concentrations inserted into the regression equation for single-analyst RSD were the mean recoveries shown in Table 21.

* Precision for waters which indicted statistical significant matrix effects.

the regression equations for several of the compounds.

Accuracy of the Method

The percentage recovery of all PNA's for a specific water type ranged from 43-110 percent. The average recovery for all water types for each PNA ranged from 55-90 percent with acenaphthene and chrysene exhibiting the lowest and highest recovery, respectively.

During the method development phase, BCL determined the percentage recovery for each of the PNA's (8). These recoveries (Table 21) were generally at the lower end of the concentration range of the method validation study, and were obtained from spiked wastewater samples. Comparing these results with the average percent recovery for all water types at similar concentrations, it is evident that the percentage recoveries for the method study are significantly lower than the method development recoveries for most PNA's. Chrysene and benzo(k)fluoranthene appear to be the exceptions, however, it should be noted that chrysene and benzo(k)fluoranthene have excessively high recoveries of 108 and 110 percent, respectively, for Wastewater C-95. Examination of the summary statistics for chrysene indicates an excessive positive bias for the medium and high Youden pairs. Further examination of the chrysene raw data for these Youden pairs indicates that Laboratories #108, #110, and #113 reported data as high as 285 percent of the true value for the middle Youden pair and Laboratories #103, #110, and #117 as high as 252 percent of the true values for the high Youden pair. Such data is not rejected by the outlier test, therefore, they tend to distort the percentage recovery (bias) in the summary statistics and subsequently the slope of the regression equation. Also, since there appears to be no significant background contamination in this water type, the random errors are probably due to dilution, calibration or calculation errors. A similar situation exists for benzo(k)fluoranthene, Wastewater C-95, low Youden pair, in which the percentage recoveries were as high as 673 percent, and for surface water in which the low Youden pair recovery was as high as 693 percent.

The reason for the overall lower recoveries compared to the single laboratory data obtained during method development is not clear. However, it should be noted that the recoveries of the PNA's for distilled water were generally lower than for wastewater samples, and especially pronounced for those PNAs eluting after benzo(a)anthracene. Intuitively, one would anticipate that the data would be somewhat better for distilled water, since there is little chance of interferences or matrix effects. Since the distilled water data were in all cases collected prior to wastewater data, the analyst were more experienced in utilizing the method when they analyzed the wastewater samples. This may have resulted in a learning curve effect which improved the data for wastewater as compared to distilled water. This effect may have been a result of a general lack of familiarity with HPLC as well as the details of Method 610.

Precision of the Method

The overall and single operator percent relative standard deviations, in general, for a specific PNA were similar for the various water types. The overall and single-analyst percent relative standard deviations ranged from 16-91 percent and 11-50 percent, respectively.

Based upon the average percent overall relative standard deviation for all water types, acenaphthylene was the most precise (34 percent RSD) and benzo(k)fluoranthene the least precise (70 percent RSD). The average single-analyst percent Relative Standard Deviation for all water types ranged from 21-34 percent. Anthracene was the most precise and dibenzo(a,h)anthracene the least precise.

Operational Problems

Several operational problems were reported by the laboratories while conducting Method 610 analyses, the most relevant of which were:

- Concentration of the acetonitrile to a final volume of 1 mL was time consuming. Concentration to approximately 2 mL was found to be much more appropriate by some of the laboratories. In addition, several laboratories reported "bumping" problems during the concentration step which led to significant loss of all analytes.

- Bubbles (due to solvent evaporation) were found in the silica gel column, although this did not appear to distort the elution pattern.

- HPLC column performance was found to be somewhat variable. Some laboratories had to try two or three reverse phase HPLC columns* supplied by Perkin-Elmer before they found one that would adequately separate benzo(g,h,i)perylene and dibenzo(a,h)anthracene. Perkin-Elmer's current QA procedures supposedly will eliminate this problem. Other compounds were generally well resolved on these reversed phase columns.

- Some of the older HPLC systems did not deliver stable gradients and, therefore, retention times for the PNA's were variable.

- Fluorescence detector response for the various compounds was quite different from one type to the next. Two laboratories used filter type excitation, rather than a grating monochromator, which produces a much higher relative response for anthracene causing it to interfere with fluoranthene. Mercury vapor lamps were found to give a low output at 280 nm, resulting in low response for all compounds. Use of a phosphor coated lamp improved the situation somewhat. In general, fluorescence detectors employing deuterium lamps and grating monochromators for excitation gave consistent results. However, close inspection of the data did not reveal any systematic differences between deuterium source/grating instruments and mercury source/filter instruments.

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* Reverse phase column, HC - ODS Sil-X, 250 mm x 2.6 mm ID.

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APPENDIX A

POLYNUCLEAR AROMATIC HYDROCARBONS

METHOD 610

1. Scope and Application

1.1 This method covers the determination of certain polynuclear aromatic hydrocarbons (PAH). The following parameters may be determined by this method:

Parameter	Storet No.	Parameter	Storet No.
Acenaphthene	34205	Chrysene	34320
Acenaphthylene	34200	Dibenzo(ah)anthracene	34556
Anthracene	34220	Fluoranthene	34376
Benzo(a)anthracene	34526	Fluorene	34381
Benzo(a)pyrene	34247	Indeno(1,2,3-cd)pyrene	34403
Benzo(b)fluoranthene	34230	Naphthalene	34696
Benzo(ghi)perylene	34521	Phenanthrene	34461
Benzo(k)fluoranthene	34242	Pyrene	34469

1.2 This method is applicable to the determination of these compounds in municipal and industrial discharges. It is designed to be used to meet the monitoring requirements of the National Pollutant Discharge Elimination System (NPDES). As such, it presupposes a high expectation of finding the specific compounds of interest. If the user is attempting to screen samples for any or all of the compounds above, he must develop independent protocols for the verification of identity.

1.3 The sensitivity of this method is usually dependent upon the level of interferences rather than instrumental limitations. The limits of detection listed in Table A-1 represent sensitivities that can be achieved in wastewaters.

1.4 This method is recommended for use only by experienced residue analysts familiar with High Performance Liquid Chromatography (HPLC) or under the close supervision of such qualified persons.

2. Summary of Method

2.1 A 1-liter sample of wastewater is extracted with methylene chloride using separatory funnel techniques. The extract is dried and concentrated to a volume of 10 mL or less. HPLC conditions are described which allow for the accurate measurement of the compounds in the extract.

2.2 If interferences are encountered, the method provides a selected general purpose cleanup procedure to aid the analyst in their elimination.

3. Interferences

3.1 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines causing misinterpretation of chromatograms. All of these materials must be demonstrated to be free from interferences under the conditions of the analysis. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be required.

3.2 Interferences coextracted from the samples will vary considerably from source to source, depending upon the diversity of the industrial complex or municipality being sampled. While general cleanup techniques are provided as part of this method, unique samples may require additional cleanup approaches to achieve the sensitivities stated in Table A-1.

TABLE A-1. HIGH PERFORMANCE LIQUID CHROMATOGRAPHY[a] OF PNAs

Compound	Retention Time (minutes)	Detection Limit, μg/L[b]	
		UV	Fluorescence
Naphthalene	16.17	2.5	20.0
Acenaphthylene	18.10	5.0	100.0
Acenaphthene	20.14	3.0	4.0
Fluorene	20.89	0.5	2.0
Phenanthrene	22.32	0.25	1.2
Anthracene	23.78	0.10	1.5
Fluoranthene	25.00	0.50	0.05
Pyrene	25.94	0.10	0.05
Benzo(a)anthracene	29.26	0.20	0.04
Chrysene	30.14	0.20	0.5
Benzo(b)fluoranthene	32.44	1.0	0.04
Benzo(k)fluoranthene	33.91	0.30	0.04
Benzo(a)pyrene	34.95	0.25	0.04
Dibenzo(a,h)anthracene	37.06	1.0	0.08
Benzo(g,h,i)perylene	37.82	0.75	0.2
Indeno(1,2,3-cd)pyrene	39.21	0.30	0.1

[a] HPLC conditions: Reverse phase HC-ODS Sil-X 2.6 x 250 mm Perkin-Elmer column; isocratic elution for 5 min. using 40% acetonitrile/60% water, then linear gradient elution to 100% acetonitrile over 25 minutes; flow rate is 0.5 mL/min.

[b] Detection limit is calculated from the minimum detectable HPLC response being equal to five times the background noise, assuming an equivalent of a 2-mL final volume of the 1-liter sample extract, and assuming an HPLC injection of 2 μL.

3.3 The extent of interferences that may be encountered using liquid chromatographic techniques has not been fully assessed. Although the chromatographic conditions described allow for a unique resolution of the specific PAH compounds covered by this method, other PAH compounds may interfere.

4. Apparatus and Materials

4.1 Sampling equipment, for discrete or composite sampling.

4.1.1 Grab sample bottle - amber glass, pint or quart volume. French or Boston Round design is recommended. The container must be washed and solvent rinsed before use to minimize interferences.

4.1.2 Bottle caps - Threaded to screw on sample bottles. Caps must be lined with Teflon. Foil may be substituted if sample is not corrosive.

4.1.3 Compositing equipment - Automatic or manual compositing system. Must incorporate glass sample containers for the collection of a minimum of 250 mL. Sample containers must be kept refrigerated during sampling. No tygon or rubber tubing may be used in the system.

4.2 Separatory funnel - 2000 mL, with Teflon stopcock.

4.3 Drying column - A 20 mm ID pyrex chromatographic column with coarse frit.

4.4 Kuderna-Danish (K-D) Apparatus

4.4.1 Concentrator tube - 10 mL, graduated (Kontes K-570050-1025 or equivalent). Calibration must be checked. Ground glass stopper (size 19/22 joint) is used to prevent evaporation of extracts.

4.4.2 Evaporative flask - 500 mL (Kontes K-57001-0500 or equivalent). Attach to concentrator tube with springs. (Kontes K-662750-0012).

4.4.3 Snyder column - three-ball macro (Kontes K-50300-0121 or equivalent.

4.4.4 Snyder column - two-ball micro (Kontes K-569001-0219 or equivalent).

4.4.5 Boiling chips - extracted, approximately 10/40 mesh.

4.5 Water bath - Heated, with concentric ring cover, capable of temperature control (± 2°C). The bath should be used in a hood.

4.6 HPLC Apparatus:

4.6.1 Gradient pumping system, constant flow.

4.6.2 Reverse phase column, HC-ODS Sil-X, 250 mm x 2.6 mm ID (Perkin Elmer No. 809-0716 or equivalent).

4.6.3 Fluorescence detector, λex 280 nm and λem 389 nm.

4.6.4 UV detector, 254 nm, coupled to fluorescence detector.

4.6.5 Strip chart recorder compatible with detectors, 250 mm (A data system for measuring peak areas is recommended).

4.7 Chromatographic column - 250 mm long x 10 mm ID with coarse fritted disc at bottom and Teflon stopcock.

5. Reagents

5.1 Preservatives:

5.1.1 Sodium hydroxide - (ACS) 10 N in distilled water.

5.1.2 Sulfuric acid - (ACS) Mix equal volumes of conc. H_2SO_4 with distilled water.

5.1.3 Sodium thiosulfate - (ACS) granular.

5.2 Methylene chloride, Pentane, Cyclohexane, High Purity Water-HPLC quality, distilled in glass.

5.3 Sodium Sulfate - (ACS) Granular, anhydrous (purified by heating at 400°C for 4 hrs.).

5.4 Stock standards - Prepare stock standard solutions at a concentration of 1.00 μg/μL by dissolving 0.100 grams of assayed reference material in pesticide quality isooctane or other appropriate solvent and diluting to volume in a 100-mL ground glass stoppered volumetric flask. The stock solution is transfered to ground glass stoppered reagent bottles, stored in a refrigerator, and checked frequently for signs of degradation or evaporation, especially just prior to preparing working standards from them.

5.5 Acetonitrile - Spectral quality.

5.6 Silica gel - 100/200 mesh desiccant (Davison Chemical grade 923 or equivalent). Before use, activate for at least 16 hours at 130°C in a foil covered glass container.

6. Calibration

6.1 Prepare calibration standards that contain the compounds of interest, either singly or mixed together. The standards should be prepared at concentrations covering two or more orders of magnitude that will completely bracket the working range of the chromatographic system. If the sensitivity of the detection system can be calculated from Table A-1 as 100 μg/L in the final extract, for example, prepare standards at 10 μg/L, 50 μg/L, 100 μg/L, 500 μg/L, etc., so that injections of 1-5 μL of each calibration standard will define the linearity of the detector in the working range.

6.2 Assemble the necessary liquid chromatographic apparatus and establish operating parameters equivalent to those indicated in Table A-1. By injecting calibration standards, establish the sensitivity limit of the detectors and the linear range of the analytical systems for each compound.

6.3 Before using any cleanup procedure, the analyst must process a series of calibration standards through the system to validate elution patterns and the absence of interferences from the reagents.

7. Quality Control

7.1 Before processing any samples, the analyst should demonstrate through the analysis of a distilled water method blank, that all glassware and reagents are interference-free. Each time a set of samples is extracted or there is a change in reagents, a method blank should be processed as a safeguard against laboratory contamination.

7.2 Standard quality assurance practices should be used with this method. Field replicates should be collected to validate the precision of the sampling technique. Laboratory replicates should be analyzed to validate the precision of the analysis. Fortified samples should be analyzed to validate the accuracy of the analysis. Where doubt exists over the identification of a peak on the chromatogram, confirmatory techniques such as fraction collection and GC-mass spectroscopy should be used.

8. Sample Collection, Preservation, and Handling

8.1 Grab samples must be collected in glass containers. Conventional sampling practices should be followed, except that the bottle must not be prewashed with sample before collection. Composite samples should be collected in refrigerated glass containers in accordance with the requirements of the program. Automatic sampling equipment must be free of tygon and other potential sources of contamination.

8.2 The samples must be iced or refrigerated from the time of collecttion until extraction. Chemical preservatives should not be used in the field unless more than 24 hours will elapse before delivery to the laboratory. If the samples will not be extracted within 48 hours of collection, adjust the sample to a pH range of 6.0-8.0 with sodium hydroxide or sulfuric acid and add 35 mg sodium thiosulfate part-per-million of free chlorine per liter.

8.3 All samples must be extracted within 7 days and completely analyzed within 30 days of collection.

9. Sample Extraction

9.1 Mark the water meniscus on the side of the sample bottle for later determination of sample volume. Quantitatively pour the entire sample into a two-liter separatory funnel. Check the pH with wide-range paper and adjust to within the range of 5-9 with sodium hydroxide or sulfuric acid.

9.2 Add 60 mL methylene chloride to the sample bottle, and shake 30 seconds to rinse the walls. Transfer the solvent into the separatory funnel, and extract the sample by shaking the funnel for two minutes with periodic venting to release vapor pressure. Allow the organic layer to separate from the water phase for a minimum of ten minutes. If the emulsion interface between layers is more than one-third the size of the solvent layer, the analyst must employ mechanical techniques to complete the phase separation. The optimum technique depends upon the sample, but may include stirring, filtration of the emulsion through glass wool, or centrifugation. Collect the methylene chloride extract in a 250-mL Ehrlenmeyer flask.

9.3 Add a second 60-mL volume of methylene chloride to the sample bottle and complete the extraction procedure a second time, combining the extracts in the Ehrlenmeyer flask.

9.4 Perform a third extraction in the same manner. Pour the combined extract through a drying column containing 3-4 inches of anhydrous sodium sulfate, and collect it in a 500-mL Kuderna-Danish (K-D) flask equipped with a 10 mL concentrator tube. Rinse the Ehrlenmeyer flask and column with 20-30 mL methylene chloride to complete the quantitative transfer.

9.5 Add 1-2 clean boiling chips to the flask and attach a three-ball Snyder column. Prewet the Snyder column by adding about 1 mL methylene chloride to the top. Place the K-D apparatus on a steaming hot (60-65°C) water bath so that the concentrator tube is partially immersed in the hot water, and the entire lower rounded surface of the flask is bathed in steam. Adjust the vertical position of the apparatus and the water temperature as required to complete the concentration in 15-20 minutes. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood. When the apparent volume of liquid reaches 1 mL, remove the K-D apparatus and allow it to drain for at least 10 minutes while cooling. Remove the Snyder column and rinse the flask and its lower joint into the concentrator tube with 1-2 mL of methylene chloride. A 5-mL syringe is recommended for this operation. Stopper the concentrator tube and store refrigerated if further processing will not be performed immediately.

9.6 Determine the original sample volume by refilling the sample bottle to the mark and transferring the liquid to a 1000 mL graduated cylinder. Record the sample volume to the nearest 5 mL.

9.7 If the sample requires cleanup before chromatographic analysis, proceed to Section 10. If the sample does not require cleanup, or if the need for cleanup is unknown, analyze an aliquot of the extract according to Section 11.

10. Cleanup and Separation

10.1 Before the silica gel cleanup technique can be utilized, the extract solvent must be exchanged to cyclohexane. Add a 1-10-mL aliquot of sample extract (in methylene chloride) and a boiling chip to a clean K-D concentrator tube. Add 4 mL cyclohexane and attach a micro-Snyder column. Prewet the micro-Snyder column by adding 0.5 mL methylene chloride to the top. Place the micro K-D apparatus on a boiling (100°C) water bath so that the concentrator tube is partially immersed in the hot water. Adjust the vertical position of the apparatus and the water temperature as required to complete concentration in 5-10 minutes. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood. When the apparent volume of the liquid reaches 0.5 mL, remove the K-D apparatus and allow it to drain for at least 10 minutes while cooling. Remove the micro-Snyder column and rinse its lower joint into the concentrator tube with a minimum of cyclohexane. Adjust the extract volume to about 2 mL.

10.2.1 Prepare a slurry of 10g activated silica gel in methylene chloride and place this in a 10 mm ID chromatography column. Gently tap the column to settle the silica gel and elute the methylene chloride.

10.2.2 Preelute the column with 40 mL pentane. Discard the eluate and just prior to exposure of the sodium sulfate layer to the air, transfer the 2 mL cyclohexane sample extract onto the column, using an additional 2 mL of cyclohexane to complete the transfer.

10.2.3 Just prior to exposure of the sodium sulfate layer to the air, add 25 mL pentane and continue elution of the column. Discard the pentane eluate.

10.2.4 Elute the column with 25 mL of 40% methylene chloride/60% pentane and collect the eluate in a 500 mL K-D flask equipped with a 10 mL concentrator tube. Elution of the column should be at a rate of about 2 mL/min.

10.2.5 Concentrate the collected fraction to less than 10 mL by K-D techniques as in 9.5, using pentane to rinse the walls of the glassware. Proceed with HPLC analysis.

11. High Performance Liquid Chromatography HPLC

11.1 Table A-1 summarizes the recommended HPLC column materials and operating conditions for the instrument. Included in this table are estimated retention times and sensitivities that should be achieved by this method. An example of the separation achieved by this column is shown in Figure A-1. Calibrate the system daily with a minimum of three injections of calibration standards.

11.2 To the extract, add 4 mL acetonitrile and a new boiling chip, then attach a micro-Snyder column. Increase the temperature of the hot water bath to 95-100°C. Concentrate the solvent as above. After cooling, remove the micro-Snyder column and rinse its lower joint into the concentrator tube with about 0.2 mL acetonitrile. Adjust the extract volume to 1.0 mL.

11.3 Inject 2-5 µL of the sample extract with a high pressure syringe. Smaller (1.0 µL) volumes can be injected in automatic devices are employed. Record the volume injected to the nearest 0.05 µL, and the resulting peak size, in area units.

11.4 If the peak area exceeds the linear range of the system, dilute the extract and reanalyze.

11.5 If the peak area measurement is prevented by the presence of interferences, further cleanup is required.

11.6. The UV detector is recommended for the determination of naphthalene and acenaphthylene and the fluorescence detector is recommended for the remaining PAHs.

12. Calculations

11.1 Determine the concentration of individual compounds according to the formula:

$$\text{Concentration, } \mu g/L = \frac{(A)\ (B)\ (V_t)}{V_i)\ \ (V_s)}$$

where A = Calibration factor for chromatographic system, in namograms material per unit peak height.

B = Peak size in injection of sample extract, in area units

V_i = Volume of extract injected (µL)

V_t = Volume of total extract (µL)

V_s = Volume of water extracted (mL).

11.2 Report results in micrograms per liter without correction for recovery data. When duplicate and spiked samples are analyzed, all data obtained should be reported.

12. Accuracy and Precision

12.1 Data is not available at this time.

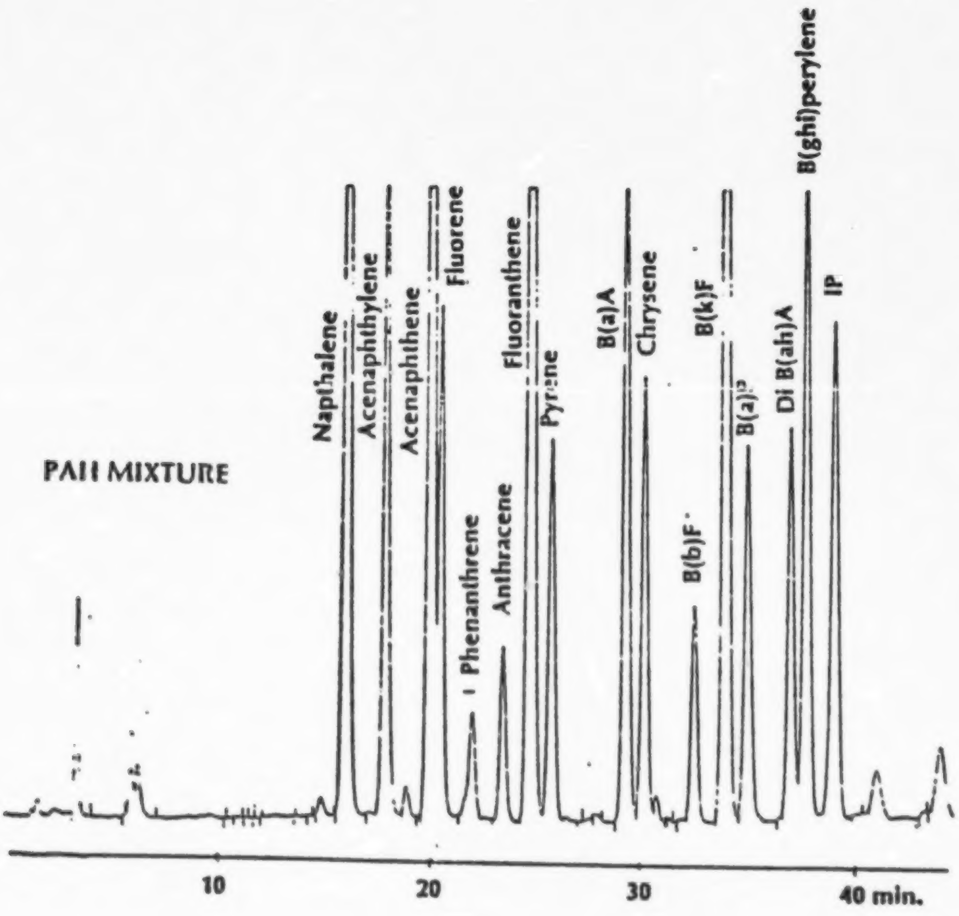

Figure A-1. HPLC-Fluorescence of PNAs on reverse phase column, HC-ODS Sil-X, 250 mm x 2.6 mm ID (Perkin Elmer No. 809-0716 or equivalent). For conditions, see Table A-1.

APPENDIX B

INSTRUCTIONS TO ANALYST

The following instructions were sent to the analyst prior to the start of the method study.

The PNA procedure is rather straighforward and easy to conduct. However, some of the compounds are light sensitive and thus exposure to light should be kept at a minimum. All sample extracts should be stored in the dark prior to analysis. The column clean-up step should be checked to make sure that proper elution is occurring.

The HPLC system performance is important since a large number of compounds must be separated. The equilibration time (at 40% acetonitrile/60% water) between runs should be at least 25 minutes and should be consistent from run to run. Solvents for HPLC must be filtered through a submicron filter and then degassed, either by heating or by a helium purge, to prevent bubble formation.

The sensitivity of the detectors should be checked daily. The following amounts of materials on column give a 1/2 scale peak at 0.5% full scale noise;

Naphthalene - 100 ng
Acenaphylene - 150 ng
Acenaphthene - 100 ng
Fluorene - 80 ng
Phenanthrene - 50 ng
Anthracene - 60 ng
Fluoranthene - 2 ng
Pyrene - 20 ng
Benzo(a)anthracene - 1.6 ng
Benzo(k)fluoranthene - 1.6 ng
Benzo(a)pyrene - 1.6 ng
Dibenzo(a,h)anthracene - 32. ng
Benzo(ghi)perylene - 8 ng
Indeno(1,2,3-cd)pyrene - 4 ng

Procedure for Spiking Water Samples

All wastewater samples for all categories will be supplied in one (1)-quart bottles with Teflon screw caps. To spike the sample, place a magnetic stirbar in the bottle, add 1 mL of the ampule concentrate, then cap and stir 15 minutes using a magnetic stirrer. Transfer the contents of the bottle to a 2-liter separatory funnel and proceed with the analysis as described in Method 610, PNAs. In calculating results, assume the volume of the sample to be one liter.

Chrysene Impurity

The impurity present in most of the chrysene standards and which was discussed at the prestudy conference has been determined to have the following characteristics:

- It co-elutes with fluorene on most HC-ODS columns.
- It has strong fluorescence but relatively weak UV absorbance under the detector conditions specified in Method 610. (i.e., it does not interfere with the determination of fluorene by UV).
- It is removed by the silica gel cleanup procedure specified in Method 610.
- A satisfactory chrysene standard may be prepared by the following procedure:

  A column containing 50 grams of silica gel (activated at 130°C) was eluted with 100 mL of methylene chloride and then 100 mL of petroleum ether. A solution (25 mL) of 40% methylene chloride in petroleum ether containing 25 mg of chrysene was applied to the column. The chrysene was then eluted with 50 mL of 40% methylene chloride in petroleum ether. This eluate was then evaporated just to dryness. The product melted sharply at 252°C (literature value 254°C). Both fluorescence and UV/HPLC gave a single peak. The peak areas obtained for chrysene before and after cleanup agree within 2% (experimental error), thus indicating that the impurity is present at less than 2%.

Since the impurity is not present at a significant level (i.e. 2% or less), and does not interfere with the fluorene determination by UV, it would be best simply to determine fluorene by UV.

Alternatively, since the impurity is removed by the silica gel cleanup, fluorescence detection may be used for the fluorene determination, provided an interference free chrysene standard is used for calibration of the instrument.

APPENDIX C

TABLE C-1. RAW DATA FOR NAPTHALENE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	10.00	13.00	10.00	13.00	10.00	13.00	10.00	13.00	10.00	13.00	10.00	13.00
LAB NUMBER												
101	5.40*	6.60*	11.00*	11.00*	1.30	26.00*	6.30	9.20	0.69*	9.40	3.00	5.20
102	0.73	8.66	0.51	1.10	6.05	8.46	5.14	3.59	4.40	8.30	4.50	8.19
103	0.00*	0.00*	0.00*	1.30	0.00*	1.30*	0.00*	5.00	3.30*	0.00*	3.30	6.00
104	3.80	5.40	5.80	5.30	6.50	8.90	7.30	9.70	6.70	10.00	7.40	10.00
108	8.76	17.80*	7.80	*	9.69*	11.70*	7.24	10.30	5.44	7.96	2.06	12.50
110	5.00	4.00	6.00	11.00	5.00	0.90	16.00	9.80	6.00	14.00	7.00	9.40
112	2.35	6.23	5.41	6.30	4.51	8.02	6.09	8.62	6.42	11.76	6.42	18.93*
113	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
115	7.90	11.10	6.30	11.60	6.80	10.40	8.50	11.60	7.00*	12.30*	7.40	9.20
116	4.39	6.70	2.33	13.20	0.97	2.83	7.41	6.86	6.03	10.70	7.86	6.80
117	0.31	2.48	4.77	9.00	1.95	3.63	2.05	7.76	6.42	8.49	< 0.20*	5.00
119	5.80	5.80	1.92	3.79	4.40	8.97	9.50	8.75	5.68	8.73	4.08	5.16
122	3.40	6.40	0.10*	7.00*	12.70	0.80	0.50*	0.50*	1.60*	0.70*	0.40*	< 0.20*
123	7.13	9.68	6.10	7.61	7.84	10.85	6.48	6.39	6.84	10.39	6.38	8.88
124	12.00	8.40	8.50	13.00	6.50	13.00	12.00	3.30	8.10	9.40	11.00	7.10
125	4.30	2.60	8.50	4.90	4.60	5.00	5.10	5.10	5.50	8.00	3.80	5.40

* = REJECTED
< = LESS THAN DETECTION LIMIT

APPENDIX C (Continued)

TABLE C-1. RAW DATA FOR NAPTHALENE ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00
LAB NUMBER												
101	99.00*	240.00*	104.00*	100.00*	86.00	74.00	78.00	74.00	34.00	59.00	58.00	50.00
102	45.80	47.30	82.10	14.30	55.30	2.10	76.80	51.60	82.10	44.60	5.15	45.20
103	12.00*	10.00*	6.60	62.00	30.00*	28.00*	24.00	60.00	26.00*	0.00*	23.00	47.00
104	57.00	52.00	52.00	62.00	54.00	48.00	77.00	44.00	74.00	48.00	60.00	72.00
108	62.30	64.50	75.20	87.40	90.20*	94.00*	106.00	102.00	36.70	65.10	81.90	126.00
110	60.00	96.00	22.00	50.00	25.00	40.00	132.00*	44.00	30.00	52.00	30.00	62.00
112	50.90	43.62	46.81	52.78	50.00	65.76	16.37	34.67	89.97	84.88	103.53	64.50
113	26.00	92.00	0.00*	0.00*	100.00	66.00	117.00	100.00	0.00*	0.00*	110.00	104.00
115	87.40	84.30	93.90	83.20	90.10	82.20	64.70	82.60	80.60*	96.70*	97.70	86.60
116	77.70	85.50	69.40	49.90	49.60	77.60	60.80	78.70	92.40	54.40	46.20	41.90
117	*	24.80	77.80	47.70	53.60	16.70	29.60	48.90	78.50	72.50	71.90	12.00
119	40.00	46.70	84.50	96.60	82.70	81.30	87.40	68.60	47.60	29.90	57.00	45.60
122	6.90	9.70	9.30*	1.30*	27.50	17.40	10.70*	40.80*	11.40*	5.30*	39.40*	19.10*
123	81.24	63.80	62.63	61.00	68.20	81.90	78.00	61.80	86.60	54.60	81.10	75.50
124	90.00	45.00	67.00	71.00	78.00	71.00	72.00	73.00	97.00	74.00	66.00	87.00
125	40.30	32.80	58.00	32.90	58.60	45.60	53.60	51.80	44.90	46.80	27.20	35.70

APPENDIX C (Continued)

TABLE C-1. RAW DATA FOR NAPTHALENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	335.00	375.00	335.00	375.00	335.00	375.00	335.00	375.00	335.00	375.00	335.00	375.00
LAB NUMBER												
101	580.00+	440.00+	230.00+	360.00+	300.00	340.00	300.00	260.00	96.00	130.00	160.00	240.00
102	88.30	267.00	181.00	270.00	187.00	832.00+	211.00	207.00	185.00	236.00	157.00	304.00
103	33.00+	54.00+	110.00	80.00	35.00+	29.00+	22.00	92.00	80.00+	100.00+	120.00	30.00
104	140.00	200.00	170.00	140.00	140.00	170.00	260.00	270.00	290.00	+	260.00	310.00
108	177.00	260.00	156.00	250.00	246.00+	410.00+	257.00	303.00	158.00	220.00	240.00	218.00
110	386.00	88.00	76.00	330.00	274.00	326.00	243.00	220.00	130.00	214.00	340.00	403.00
112	136.58	271.58	76.29	187.00	79.04	214.00	110.56	90.56	204.88	122.00	190.97	215.00
113	178.00	79.00	122.00+	33.00+	198.00	253.00	223.00	327.00	0.00+	173.50+	222.00	306.00
115	279.00	248.00	277.00	268.00	210.00	315.00	271.00	315.00	248.00+	281.00+	247.00	278.00
116	183.00	241.00	98.00	374.00	297.00	314.00	152.00	120.00	169.00	171.00	165.00	227.00
117	91.40	199.00	238.00	167.00	100.00	191.00	129.00	223.00	544.00+	294.00	160.00	506.00
119	223.00	263.00	256.00	295.00	298.00	339.00	294.00	170.00	194.00	209.00	200.00	189.00
122	161.00	9.70	23.90+	20.60+	140.80	21.40	112.90+	77.60+	98.70+	+	27.60+	29.20+
123	273.00	202.00	231.00	280.00	222.00	246.00	211.00	277.00	262.00	278.00	233.00	246.00
124	206.00	269.00	254.00	270.00	202.00	59.00	259.00	251.00	248.00	206.00	264.00	198.00
125	226.90	210.90	144.10	146.30	174.90	171.30	163.90	191.20	137.10	144.60	137.90	179.70

APPENDIX C (Continued)

TABLE C-2. RAW DATA FOR ACENAPHTHYLENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00
LAB NUMBER												
101	6.80	11.00	19.00+	30.00+	8.00+	13.00+	19.00+	29.00+	6.20	14.00	9.70	14.00
102	0.39	10.10	0.00+	4.19	5.61	9.28	5.10	9.63	4.38	10.80	4.70	10.40
103	0.00+	0.00+	0.00+	2.20	0.00+	4.80+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
104	4.20	6.60	5.30	6.70	6.50	11.00	8.20	12.00	7.60	13.00	9.00	12.00
108	9.66	4.95	6.61	+	10.40+	12.60+	9.55	12.00	10.70	9.03	4.78	+
110	2.40	5.00	3.00	8.00	3.00	6.08	5.40	7.60	1.60	5.40	2.60	5.80
112	2.91	9.21	4.72	6.98	5.71	10.43	7.16	11.34	6.50	12.03	6.73	12.77
113	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
115	6.80	11.00	7.40	12.40	7.40	11.60	7.80	14.60	6.90	12.40	7.60	12.00
116	6.89	9.77	3.70	14.50	5.92	3.95	6.73	10.90	11.50	12.20	10.50	11.60
117	0.47	0.93	4.08	8.78	3.48	7.34	3.39	13.80	8.14	13.00	< 0.30+	10.50
119	6.01	2.63	3.70	6.54	4.77	7.62	7.89	6.55	3.95	5.94	3.29	7.97
122	5.20	28.10+	1.00	< 1.40+	< 1.40+	8.50	12.40	15.80	29.10+	< 1.40+	29.90+	4.50
123	6.67	10.50	6.02	8.00	7.30	12.00	6.56	11.90	6.45	7.32	6.17	9.79
124	9.60	11.00	2.10	10.00	2.60	13.00	10.00	3.70	7.20	9.90	11.00	7.10
125	7.20	7.60	7.20	6.70	6.00	5.60	6.60	8.00	7.20	10.70	5.40	7.90

APPENDIX C (Continued)

TABLE C-2. RAW DATA FOR ACENAPHTHYLENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00	110.00	90.00
LAB NUMBER												
101	96.00	94.00	180.00	170.00	94.00+	81.00+	290.00+	130.00+	120.00	130.00	66.00	91.00
102	89.30	58.60	84.40	31.70	89.40	68.90	85.70	73.00	90.70	63.40	74.70	62.70
103	13.00+	19.00+	39.00	98.00	50.00+	61.00+	4.40+	85.00+	0.74+	48.00+	0.74+	70.00+
104	68.00	62.00	57.00	78.00	68.00	65.00	89.00	58.00	83.00	48.00	70.00	90.00
108	65.50	67.00	64.00	81.50	111.00+	+	141.00	132.00	69.60	96.50	88.60	159.00
110	32.60	27.00	13.00	86.00	16.00	32.80	108.00+	44.60	31.60	40.40	40.60	11.00
112	55.56	51.81	54.03	63.16	63.89	64.07	31.66	44.38	77.06	92.11	72.51	69.75
113	60.00	98.00	45.00	27.00	100.00	83.00	121.00	116.00	60.00	43.00	102.00	121.00
115	100.20	102.70	98.20	94.90	95.30	97.50	79.80	94.90	88.00	101.70	93.80	104.60
116	74.30	92.80	58.90	50.40	95.00	83.00	77.90	85.70	101.00	66.30	68.70	88.80
117	8.40	9.80	74.60	67.00	55.70	60.30	54.70	60.50	99.10	24.60	94.70	54.40
119	74.10	45.70	82.40	83.30	66.70	73.30	58.60	83.40	69.00	47.20	64.90	66.50
122	12.10	< 1.40+	155.40	1.70	140.90	27.20	118.20	704.30+	2.90	127.20	247.30+	139.50
123	78.00	66.20	54.90	66.10	67.60	86.10	83.50	89.20	78.00	66.10	79.40	85.30
124	90.00	26.00	66.00	86.00	80.00	80.00	80.00	64.00	74.00	85.00	66.00	106.00
125	34.00	37.40	72.80	50.80	65.40	63.80	71.80	75.90	62.30	39.50	51.00	58.40

APPENDIX C (Continued)

TABLE C-2. RAW DATA FOR ACENAPHTHYLENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	425.00	375.00	425.00	375.00	425.00	375.00	425.00	375.00	425.00	375.00	425.00	375.00
LAB NUMBER												
101	380.00	370.00	300.00	250.00	550.00+	370.00+	630.00+	490.00+	480.00	420.00	400.00	300.00
102	178.00	298.00	360.00	290.00	380.00	237.00	421.00	242.00	381.00	218.00	387.00	286.00
103	170.00+	120.00+	260.00	89.00	190.00+	140.00+	13.00+	71.00+	26.00+	27.00+	65.00+	11.00+
104	260.00	230.00	290.00	160.00	260.00	210.00	490.00	320.00	570.00	+	480.00	370.00
108	341.00	192.00	277.00	186.00	456.00+	480.00+	476.00	420.00	336.00	386.00	433.00	243.00
110	672.00	32.40	144.00	330.00	386.00	228.00	342.00	230.00	272.00	230.00	428.00	494.00+
112	117.00	117.00	114.00	191.00	121.42	212.00	109.00+	87.00	304.83	117.00	316.20	253.00
113	411.00	255.00	246.00	230.00	417.00	300.00	350.00	349.00	149.00	227.00	368.00	333.00
115	374.00	263.00	461.00	277.00	369.00	340.00	470.00	341.00	448.00	320.00	435.00	319.00
116	372.00	288.00	250.00	292.00	364.00	267.00	291.00	218.00	272.00	247.00	284.00	218.00
117	473.00	168.00	469.00	218.00	209.00	318.00	319.00	323.00	1271.00+	371.00	489.00	701.00+
119	420.00	332.00	433.00	351.00	451.00	319.00	475.00	0.29	334.00	237.00	350.00	268.00
122	1018.30+	87.10	16.30	668.40+	233.20	< 1.40+	1220.10+	438.40	982.20+	+	724.10+	1189.60+
123	259.00	310.00	353.00	273.00	430.00	248.00	416.00	273.00	261.00	266.00	415.00	248.00
124	377.00	332.00	363.00	305.00	269.00	127.00	433.00	270.00	429.00	199.00	430.00	231.00
125	420.80	262.40	330.90	193.40	318.60	226.90	384.50	255.40	302.80	236.50	310.10	259.60

APPENDIX C (Continued)

TABLE C-3. RAW DATA FOR ACENAPHTHENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	10.00	12.00	10.00	12.00	10.00	12.00	10.00	12.00	10.00	12.00	10.00	12.00
LAB NUMBER												
101	5.00+	5.80+	12.00+	13.00+	4.10+	7.90+	7.40	11.00	6.60	9.10	6.80	7.80
102	1.76	13.10	2.19	6.35	3.00	6.79	5.32	7.79	1.82	6.20	3.28	7.09
103	0.00+	0.00+	0.00+	1.00	0.00+	4.00	0.00+	2.00	0.00+	0.00+	0.00+	0.00+
104	4.10	4.60	5.80	4.90	6.70	8.70	6.80	10.00	6.30	9.80	6.20	9.10
108	4.61	+	4.95	+	2.75	3.99	+	4.56	+	4.04	+	0.00+
110	16.00	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+	< 10.00+
112	2.55	5.14	4.14	5.38	3.53	6.93	6.66	9.52	6.90	9.61	5.11	7.45
113	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
115	6.90	8.60	7.00+	9.60+	6.20+	8.10+	7.30+	10.60+	6.10	7.10	6.90	7.50
116	0.29+	0.51+	0.18+	0.71+	0.28+	0.30+	0.40+	0.48+	0.60+	0.68+	0.62+	0.61+
117	1.83	2.44	4.82	6.43	3.78	6.30	3.58	8.58	8.19+	9.56+	0.00+	8.58
119	3.95	2.63	4.90	6.54	6.23	7.62	6.31	7.62	5.44	5.94	5.31	7.97
122	2.40	5.30	0.20	< 0.50+	< 0.50+	< 0.50+	< 0.50+	< 0.50+	7.40	< 0.50+	9.30	3.50+
123	0.68+	0.82+	0.56	0.70	0.34	0.83	0.45	0.86	0.56	0.40	0.18	0.64+
124	17.00	11.00	1.50	16.00+	4.30	15.00	17.00+	3.50	12.00	7.70	13.00	6.70
125	5.40	5.60	6.60	4.50	6.80	5.70	7.20	6.50	7.10	10.20	6.10	6.90

APPENDIX C (Continued)

TABLE C-3. RAW DATA FOR ACENAPHTHENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	120.00	95.00	120.00	95.00	120.00	95.00	120.00	95.00	120.00	95.00	120.00	95.00
LAB NUMBER												
101	110.00+	150.00+	120.00+	90.00+	99.00+	73.00+	100.00	69.00	54.00	60.00	68.00	55.00
102	97.40	49.00	95.50	22.00	94.00	62.20	99.60	72.70	94.70	50.40	85.20	48.40
103	29.00	15.00	43.00	54.00	44.00	41.00	29.00	75.00	1.00	45.00	1.50	60.00
104	66.00	52.00	53.00	57.00	62.00	50.00	85.00	46.00	78.00	40.00	67.00	74.00
108	30.80	26.20	39.10	36.40	55.00	52.10	70.40	42.10	20.50	53.70	38.40	57.10
110	42.00	14.00	53.00	35.00	17.00	48.00	37.00	42.00	54.00+	14.00+	54.00	10.00
112	65.22	50.17	66.29	63.16	68.30	55.96	34.25	43.00	88.24	72.20	92.81	71.76
113	79.00	100.00	50.00	50.00	75.00	83.00	118.00	0.00+	74.00	59.00	88.00	0.00+
115	111.90	63.40	101.80+	86.10+	104.00+	93.00+	109.10+	85.60+	99.80	90.50	90.50	72.50
116	6.57+	5.14+	4.99+	4.80+	3.21+	6.04+	6.11+	5.49+	6.43+	3.50+	4.09+	5.20+
117	22.00	19.50	80.40	58.80	70.60	45.40	51.50	51.50	94.60+	87.40+	107.00	47.20
119	67.40	40.00	89.60	64.90	80.00	63.10	92.00	71.50	69.30	61.80	77.90	70.60
122	4.30	6.80	46.10	< 0.50+	47.40+	6.30+	22.90	78.70+	< 0.50+	29.50	66.60	32.30
123	2.35+	5.70+	6.54	5.91	7.46	7.29	9.27	7.24	7.98	6.10	5.36	7.13
124	106.00	29.00	78.00	95.00	95.00	79.00	103.00	57.00	88.00	82.00	82.00	98.00
125	51.30	20.00	73.30	43.80	78.20	55.10	89.50	77.30	75.20	61.40	60.70	56.00

APPENDIX C (Continued)

TABLE C-3. RAW DATA FOR ACENAPHTHENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	235.00	260.00	235.00	260.00	235.00	260.00	235.00	260.00	235.00	260.00	235.00	260.00
LAB NUMBER												
101	350.00+	660.00+	220.00+	290.00+	230.00+	270.00+	220.00	210.00	83.00	110.00	130.00	190.00
102	60.50	199.00	144.00	201.00	165.00	160.00	178.00	143.00	159.00	133.00	151.00	194.00
103	75.00	85.00	95.00	76.00	68.00	84.00	26.00	85.00	74.00	58.00	100.00	33.00
104	100.00	140.00	120.00	97.00	100.00	130.00	200.00	190.00	220.00	*	200.00	230.00
108	67.00	88.60	56.40	89.50	76.80	142.00	86.70	310.00	84.00	127.00	183.00	125.00
110	104.00	30.00	56.00	110.00	11.00	28.00	17.00	22.00	28.00+	12.00+	91.00	120.00
112	127.00	219.00	68.05	156.00	133.25	172.87	111.00	129.00	170.21	135.00	177.47	213.30
113	177.00	145.00	140.00	140.00	222.00	222.00	208.00	200.00	108.00	200.00	208.00	250.00
115	229.00	175.00	213.00+	203.00+	143.00+	243.00+	234.00+	246.00+	227.00	242.00	214.00	245.00
116	10.30+	16.20+	11.40+	27.70+	14.80+	14.20+	12.10+	10.10+	7.05+	12.50+	9.21+	16.20+
117	257.00	97.60	196.00	140.00	126.00	210.00	114.00	214.00	546.00+	259.00+	257.00	473.00+
119	219.00	219.00	216.00	239.00	210.00	210.00	229.00	191.00	237.00	217.00	214.00	214.00
122	218.10	18.40	1.90	117.40	35.60+	< 0.50+	192.70	65.60	152.70	*	79.40	208.70
123	18.40+	14.70+	17.10	20.00	18.70	15.80	17.80	17.40	12.50	19.70	20.10	13.70
124	177.00	203.00	168.00	179.00	416.00+	103.00	220.00	199.00	188.00	163.00	211.00	179.00
125	185.80	173.30	160.50	147.60	147.60	160.30	176.90	192.30	170.30	179.20	156.00	181.40

APPENDIX C (Continued)

TABLE C-4. RAW DATA FOR FLUORENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	10.00	25.40	10.00	25.40	10.00	25.40	10.00	25.40	10.00	25.40	10.00	25.40
LAB NUMBER												
101	4.70	12.00	12.00+	30.00+	4.40+	19.00+	8.70+	24.00+	9.60	24.00	6.40	20.00
102	6.02	16.60	4.73	14.80	6.52	14.60	5.39	16.40	4.43	17.90	4.81	17.20
103	3.80	7.50	2.90	5.80	4.50	8.70	2.30	15.00	2.40	6.00	5.20	11.00
104	0.04+	0.07+	0.10+	0.09+	< 0.06+	0.15+	< 0.03+	0.33+	< 0.03+	0.18+	< 0.06+	0.18+
108	5.24	13.94	4.36	15.90	6.30	142.00+	5.88	10.70	5.10	8.61	3.88	18.50
110	12.00	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+	< 5.00+
112	2.85	14.40	4.52	14.33	5.65	17.88	6.28	23.65	7.46	16.42	6.50	15.04
113	3.60	17.00	5.60	23.00	0.00+	22.00	9.10	24.00	7.00	9.50	7.00+	25.00+
115	7.00	18.60	7.50	20.60	6.80	17.80	8.00	20.60	6.80+	18.60+	7.50+	17.90+
116	9.80	20.60	7.48	23.10	9.01	18.10	7.06	24.60	11.70+	264.00+	11.40	31.83+
117	1.18	3.27	6.05	17.60	4.17	10.20	4.15	17.10	6.68	16.50	0.86	12.60
119	5.27	12.40	3.97	8.19	4.45	11.70	7.06	10.40	5.57	11.70	3.97	10.70
122	3.10	9.80	0.60	1.40	1.30	0.50	5.20+	9.60+	9.70	0.10	10.20	7.90
123	7.01	17.20	5.78	12.70	7.72	18.80	6.60	18.40	6.14	11.50	6.41	15.40
124	4.60	17.00	1.20	12.00	4.30	16.00	5.30	5.50	4.70	11.00	4.50	8.80
125	1.50	1.10	0.50+	1.70+	- 0.19+	0.90	3.50	4.00	0.20+	0.70+	0.10+	0.40+

APPENDIX C (Continued)

TABLE C-4. RAW DATA FOR FLUORENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	90.00	115.00	90.00	115.00	90.00	115.00	90.00	115.00	90.00	115.00	90.00	115.00
LAB NUMBER												
101	63.00	150.00	79.00*	130.00*	90.00*	140.00*	100.00*	120.00*	65.00	100.00	61.00	72.00
102	70.80	67.80	73.10	42.30	71.30	88.60	73.10	79.90	75.10	79.20	69.90	73.40
103	26.00	21.00	63.00	87.00	60.00	7.10	0.00*	67.00	59.00	69.00	39.00	71.00
104	0.81*	0.94*	< 0.02*	0.63*	0.54*	0.68*	0.63*	0.57*	< 0.30*	< 0.40*	< 0.50*	1.00*
108	33.30	26.20	31.00	44.80	57.60	91.50	56.50	719.00*	34.30	32.50	49.60	73.90
110	19.60	9.00	31.00	20.00	16.00*	28.00*	24.00	26.00	20.00*	16.00*	19.80	7.00
112	51.76	56.38	58.17	53.07	46.66	68.92	45.18	31.11	12.26	9.63	14.22	77.70
113	61.00	99.00	60.00	70.00	83.00	77.00	86.00	111.00	65.00	71.00	91.00*	109.00*
115	84.50	109.00	84.00	106.00	82.00	107.00	69.40	98.00	70.60*	106.00*	71.30*	93.00*
116	54.60	98.60	45.30	72.10	98.00	91.70	68.20	92.80	78.60*	49.90*	82.80	105.00
117	25.20	25.90	72.00	92.20	46.10	70.90	48.70	51.70	68.40	75.50	45.60	42.20
119	75.20	80.00	78.20	101.00	62.10	80.40	54.40	125.00	64.80	65.10	46.40	58.40
122	4.80	14.50	25.10	2.60	29.00	15.60	21.70*	38.50*	0.50	25.90	34.10	29.80
123	65.80	70.10	39.80	68.50	57.00	91.60	70.60	96.50	65.90	72.10	68.10	90.30
124	66.00	33.00	54.00	92.00	61.00	75.00	69.00	56.00	56.00	85.00	58.00	106.00
125	2.20	63.40	2.30*	1.60*	25.80	12.50	17.50	24.80	1.90*	2.80*	2.00*	4.00*

APPENDIX C (Continued)

TABLE C-4. RAW DATA FOR FLUORENE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	270.00	463.00	270.00	463.00	270.00	463.00	270.00	463.00	270.00	463.00	270.00	463.00
LAB NUMBER												
101	310.00	630.00	220.00*	430.00*	360.00*	550.00*	300.00*	440.00*	120.00	220.00	190.00	330.00
102	106.00	408.00	210.00	428.00	211.00	355.00	210.00	341.00	195.00	300.00	202.00	392.00
103	69.00	71.00	73.00	110.00	71.00	79.00	59.00	63.00	91.00	75.00	75.00	76.00
104	1.30*	2.20*	1.40*	1.30*	1.20*	2.00*	< 0.08*	3.00*	< 1.20*	*	< 1.20*	4.30*
108	113.00	193.00	84.70	260.00	140.00	348.00	131.00	309.00	151.00	299.00	108.00	107.00
110	46.00	80.00	23.00	[illegible]	14.00*	38.00*	58.00	22.00	55.00*	24.00*	82.00	144.00
112	52.88	10.82	55.72	5.59	95.75	11.40	36.46	6.83	28.76	27.90	4.00	7.36
113	203.00	405.00	137.00	340.00	108.00	400.00	194.00	414.00	147.00	324.00	200.00*	380.00*
115	229.00	285.00	212.00	305.00	174.00	380.00	249.00	378.00	250.00*	429.00*	235.00*	420.00*
116	247.00	399.00	218.00	405.00	203.00	388.00	221.00	375.00	226.00*	437.00*	139.00	258.00
117	181.00	268.00	304.00	335.00	108.00	467.00	165.00	292.00	554.00*	370.00	185.00	591.00
119	268.00	444.00	256.00	458.00	241.00	365.00	288.00	427.00	194.00	317.00	186.00	304.00
122	< 0.04*	24.90	15.10	65.10	80.00	0.50	< 0.04*	< 0.04*	< 0.04*	*	39.30	< 0.04*
123	329.00	166.00	191.00	355.00	232.00	319.00	222.00	359.00	110.00	348.00	222.00	306.00
124	184.00	400.00	197.00	356.00	93.00	168.00	235.00	328.00	219.00	250.00	234.00	288.00
125	13.50	20.90	9.20*	16.40*	21.70	25.70	6.40	36.70	7.10*	12.90*	7.60*	13.50*

APPENDIX C (Continued)

TABLE C-5. RAW DATA FOR PHENANTHRENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00
LAB NUMBER												
101	3.50	3.10	6.70+	7.10+	2.50	3.80	4.00	4.70	3.50	4.70	3.70	4.30
102	3.35	5.35	2.71	4.37	3.62	4.84	2.88	4.38	2.73	5.16	2.77	4.45
103	2.80	2.60	0.00+	2.50+	0.00+	4.10	0.00+	5.10	0.91+	2.90+	2.80	2.70
104	1.90	1.90	2.50	2.20	3.10	3.90	3.20	4.10	2.90	4.00	2.80	4.10
108	2.97	0.99	2.57	4.48	3.23	3.97	2.71	4.60	2.10	2.27	1.96	4.80
110	1.60	2.00	1.40	3.50	2.40	3.54	3.60	4.40	2.40	2.60	2.60	3.40
112	2.05	6.80+	2.63	11.56+	5.74+	16.00+	3.38	2.64	3.29	4.44	2.00	4.21
113	3.10	4.60	3.20	5.60	4.60	5.10	3.80	5.00	3.80	3.70	4.20	5.60
115	4.30	4.70	3.00	4.50	4.70+	5.10+	4.20+	5.10+	3.80+	5.80+	4.60+	5.20+
116	2.97	5.25	2.37	5.05	2.76	2.76	2.83	4.81	4.38	5.24	4.96	5.55
117	0.68	1.81	3.27	4.34	2.86	3.30	2.67	5.91	4.31+	5.49+	1.34	4.56
119	3.84	3.34	2.71	2.71	3.16	2.98	2.76	3.41	2.31	2.81	2.06	3.22
122	< 2.50+	3.00	< 2.50+	< 2.50+	< 2.50+	< 2.50+	< 2.50+	< 2.50+	4.50	< 2.50+	< 2.50+	< 2.50+
123	2.84	3.45	2.13	3.40	2.79	3.51	3.27	3.52	1.84+	2.24+	3.13	3.70
124	2.80	2.00	0.61	4.60	3.40	5.30	3.40	1.90	2.60	2.90	2.30	2.60
125	4.10	2.80	4.00	3.40	4.20	3.80	4.00	4.00	3.70	5.10	3.00	3.60

APPENDIX C (Continued)

TABLE C-5. RAW DATA FOR PHENANTHRENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C 93)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	60.00	50.00	60.00	50.00	60.00	50.00	60.00	50.00	60.00	50.00	60.00	50.00
LAB NUMBER												
101	55.00	64.00	63.00+	44.00+	47.00	38.00	59.00	38.00	30.00	34.00	34.00	33.00
102	49.90	30.30	46.40	17.90	47.60	39.00	47.90	37.20	49.80	33.40	46.40	30.20
103	24.00	16.00	30.00+	24.00+	27.00	24.00	0.00+	25.00	27.00+	25.00+	25.00	29.00
104	28.00	22.00	22.00	26.00	29.00	24.00	38.00	21.00	34.00	16.00	30.00	33.00
108	21.20	39.90	25.30	20.90	40.50	42.20	41.90	33.30	17.70	21.60	32.30	37.70
110	91.00	55.00	48.40	48.60	47.00	63.00	78.40	66.00	70.00	52.60	71.60	19.60
112	30.64	25.81	46.30	35.03	43.65	30.80	18.95	22.87	37.88	29.51	60.43	16.09
113	55.00	54.00	56.00	29.00	48.00	39.00	58.00	67.00	45.00	37.00	50.00	22.00
115	64.40	53.10	58.80	47.10	61.70+	48.60+	54.50+	50.60+	56.10+	50.70+	59.80+	46.10+
116	43.90	42.60	31.10	36.90	42.80	45.40	47.80	40.20	48.00	23.40	50.10	42.30
117	20.40	12.60	49.30	40.80	32.90	33.60	34.70	26.10	52.40+	44.00+	42.90	25.40
119	55.10	31.60	51.00	40.80	43.70	36.20	54.90	39.80	53.60	32.90	34.90	27.40
122	6.90	13.50	57.90	3.60	49.80	9.90	19.20+	83.40+ <	2.50+	27.50	39.70	15.90
123	35.20	22.60	16.60	19.50	57.00	91.60+	35.60	35.60	33.20+	23.00+	13.40	41.00
124	47.00	20.00	40.00	41.00	47.00	37.00	47.00	34.00	43.00	39.00	45.00	48.00
125	35.20	38.20	43.30	33.00	46.30	33.10	48.60	37.80	44.20	38.50	40.70	37.30

APPENDIX C (Continued)

TABLE C-5. RAW DATA FOR PHENANTHRENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	205.00	280.00	205.00	280.00	205.00	280.00	205.00	280.00	205.00	280.00	205.00	280.00
LAB NUMBER												
101	240.00	370.00	180.00+	310.00+	180.00	250.00	190.00	230.00	80.00	130.00	120.00	200.00
102	91.50	269.00	165.00	276.00	169.00	220.00	160.00	210.00	158.00	192.00	169.00	240.00
103	28.00	24.00	26.00+	32.00+	26.00	31.00	24.00+	24.00+	37.00+	33.00+	31.00	29.00
104	78.00	120.00	79.00	79.00	76.00	110.00	140.00	180.00	160.00	+	150.00	220.00
108	157.00	148.00	138.00	150.00	115.00	206.00	106.00	174.00	113.00	169.00	102.00	111.00
110	275.00	269.00	207.00	342.00	210.00	342.00	207.00	292.00	211.00	266.00	253.00	342.00
112	81.79	194.20	75.18	165.00	28.64	139.00	185.67	231.00	194.93	246.00	130.05	184.00
113	217.00	200.00	120.00	200.00	65.00	214.00	173.00	224.00	150.00	195.00	189.00	266.00
115	209.00	228.00	197.00	227.00	175.00+	275.00+	192.00+	315.00+	199.00+	266.00+	220.00+	281.00+
116	186.00	280.00	167.00	323.00	193.00	250.00	208.00	228.00	161.00	285.00	117.00	229.00
117	190.00	187.00	211.00	191.00	90.30	268.00	135.00	226.00	480.00+	247.00+	181.00	462.00
119	183.00	264.00	190.00	264.00	175.00	229.00	193.00	210.00	169.00	203.00	130.00	189.00
122	127.90	35.90	60.00	135.00	81.70	< 2.50+	147.60+	188.20+	230.00	+	49.80	218.20
123	148.00	114.00	102.00	142.00	232.00	319.00	150.00	176.00	58.30+	154.00+	167.00	186.00
124	163.00	284.00	181.00	231.00	129.00	133.00	194.00	231.00	192.00	199.00	192.00	212.00
125	162.50	199.60	163.90	179.00	130.30	156.40	140.90	159.50	147.00	149.30	134.60	155.60

APPENDIX C (Continued)

TABLE C-6. RAW DATA FOR ANTHRACENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00
LAB NUMBER												
101	10.00+	13.00+	9.30+	15.00+	7.40+	11.00+	10.00+	14.00+	7.30	13.00	9.20	12.00
102	6.53	15.80	1.97	6.72	7.43	21.10+	6.86	11.30	5.74	12.00	4.62	9.80
103	2.70+	1.50+	1.30+	3.90+	1.50+	2.80+	0.95+	0.00+	0.00+	0.00+	0.00+	0.00+
104	2.90	4.30	3.70	4.10	5.30	7.90	5.70	7.60	5.20	8.40	5.20	8.30
108	5.77	2.36	4.50	6.74	6.57	8.18	4.44	7.92	3.87	5.35	4.04	10.40
110	6.80	6.00	6.40	11.80	8.40	6.67	11.70	12.50	7.20	7.60	9.50	8.60
112	2.30	11.31	3.43	102.81+	5.39	107.71+	6.13	10.61	7.02	11.73	8.40	8.48
113	7.00	9.90	6.00	10.50	8.20	12.00	7.90	11.60	7.20	7.50	7.80	10.80
115	3.10	7.50	5.00	7.40	2.70	8.30	6.50	10.10	4.20	7.80	6.30	8.40
116	5.29	9.94	3.30	9.10	4.98	5.24	5.51	9.32	8.57	10.60	9.00	11.00
117	0.40	0.15	3.26	4.95	5.50	7.51	11.00	3.43	7.50+	10.70+	4.21	10.90
119	6.69	6.43	4.42	6.16	4.97	7.74	7.09	8.50	5.42	6.71	4.51	7.45
122	1.80+	4.80+	< 0.90+	< 0.90+	< 0.90+	< 0.90+	2.50+	3.50+	5.30+	< 0.90+	6.60	3.40+
123	8.14	10.90	6.87	3.98	6.80	9.71	4.86	11.20	6.02	7.48	6.72	8.69
124	4.50	6.20	0.37	3.20	5.30	+	4.40	2.60	3.30	3.20	3.60+	2.90+
125	7.30	7.20	7.40	6.30	8.10	6.80	7.80	8.90	7.00	11.20	5.80	8.30

APPENDIX C (Continued)

TABLE C-6. RAW DATA FOR ANTHRACENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	70.00	85.00	70.00	85.00	70.00	85.00	70.00	85.00	70.00	85.00	70.00	85.00
LAB NUMBER												
101	76.00*	77.00*	76.00*	102.00*	69.00*	78.00*	92.00*	89.00*	45.00	77.00	52.00	80.00
102	63.80	57.10	62.60	39.20	58.90	69.40	64.70	65.50	59.40	60.90	55.90	54.50
103	14.00*	9.70*	14.00*	15.00*	11.00*	13.00*	1.80*	15.00*	0.00*	15.00*	0.00*	16.00*
104	27.00	34.00	22.00	40.00	31.00	38.00	41.00	32.00	38.00	23.00	32.00	49.00
108	25.90	17.30	27.90	25.80	43.40	64.10	48.50	33.30	28.90	25.20	36.10	59.80
110	57.20	49.60	45.80	38.80	38.20	49.80	33.20	54.80	47.40	48.40	48.60	35.20
112	43.56	51.46	45.17	62.03	50.89	51.41	26.69	40.05	47.88	59.27	61.66	30.16
113	55.00	83.00	66.00	76.00	59.00	63.00	69.00	81.00	57.00	66.00	66.00	41.00
115	53.40	63.30	50.80	62.90	54.40	64.80	53.30	67.30	50.80	66.50	54.80	65.30
116	52.40	71.60	38.60	65.80	44.30	75.80	57.10	74.80	59.50	44.60	58.20	81.50
117	4.76	9.67	44.40	54.20	38.50	56.30	88.90	98.40	61.10*	*	59.60	46.80
119	56.30	47.60	57.20	71.60	50.80	58.20	66.30	65.60	59.30	49.00	40.20	49.90
122	2.10*	9.90*	24.70*	3.40*	23.80*	11.10*	13.10*	100.50*	7.70*	24.70*	27.50	1.40
123	45.80	49.00	28.10	16.80	41.90	62.30	67.10	41.30	46.80	48.30	49.50	78.40
124	21.00	35.00	10.00	35.00	16.00	18.00*	32.00	16.00	19.00	19.00	29.00*	23.00*
125	36.00	63.50	46.00	53.40	45.50	48.60	50.80	56.40	46.00	36.70	45.40	59.70

APPENDIX C (Continued)

TABLE C-6. RAW DATA FOR ANTHRACENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	400.00	350.00	400.00	350.00	400.00	350.00	400.00	350.00	400.00	350.00	400.00	350.00
LAB NUMBER												
101	360.00*	290.00*	390.00*	400.00*	500.00*	390.00*	480.00*	340.00*	200.00	220.00	320.00	320.00
102	209.00	358.00	334.00	365.00	361.00	280.00	328.00	258.00	339.00	222.00	328.00	301.00
103	22.00*	15.00*	17.00*	14.00*	19.00*	18.00*	11.00*	11.00*	12.00*	7.60*	16.00*	8.50*
104	120.00	120.00	140.00	87.00	140.00	120.00	260.00	190.00	300.00	*	260.00	240.00
108	170.00	136.00	125.00	148.00	226.00	235.00	168.00	178.00	197.00	192.00	180.00	125.00
110	82.40	65.40	72.00	48.60	80.40	61.00	61.20	60.80	64.80	78.00	71.00	52.60
112	215.87	293.00	123.71	190.03	71.26	224.00	244.14	203.21	321.75	256.41	245.81	217.00
113	342.00	277.00	232.00	288.00	348.00	290.00	394.00	300.00	336.00	271.00	387.00	261.00
115	355.00	219.00	332.00	228.00	271.00	270.00	325.00	287.00	327.00	269.00	301.00	265.00
116	351.00	346.00	323.00	415.00	368.00	303.00	388.00	274.00	308.00	390.00	267.00	342.00
117	443.00	202.00	430.00	225.00	191.00	340.00	583.00	316.00	1045.00*	344.00*	426.00	641.00*
119	364.00	312.00	372.00	334.00	356.00	284.00	391.00	286.00	341.00	277.00	261.00	251.00
122	127.90*	30.80*	142.90*	83.80*	108.00*	17.10*	165.70*	137.60*	90.60*	*	59.30	165.00
123	240.00	286.00	295.00	259.00	320.00	233.00	175.00	205.00	147.00	236.00	366.00	262.00
124	162.00	177.00	243.00	169.00	*	44.00	249.00	160.00	249.00	163.00	160.00*	163.00*
125	279.80	265.40	279.00	219.30	190.30	176.30	199.60	181.00	224.10	187.40	214.80	194.30

APPENDIX C (Continued)

TABLE C-7. RAW DATA FOR FLUORANTHENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.30	0.40	0.30	0.40	0.30	0.40	0.30	0.40	0.30	0.40	0.30	0.40
LAB NUMBER												
101	0.03+	0.05+	0.01+	0.00+	0.04+	0.00+	0.04+	0.06+	0.02+	0.03+	0.00+	0.04+
102	0.24	0.43	0.20	0.39	0.27	0.38	0.22	0.38	0.21	0.40	0.19	0.36
103	0.00+	0.24	59.00+	0.00+	18.00+	0.00+	0.30	0.61	2.60+	0.00+	0.37	0.00+
104	0.06+	0.07+	0.07+	0.08+	0.10	0.15	0.10	0.14	0.10	0.15	0.10	0.15
108	0.54	0.68+	1.62+	0.69+	0.35+	1.00+	0.21	0.86+	+	0.53	+	0.02
110	0.34+	0.46+	0.70+	0.53+	0.48+	0.36+	0.41+	0.77+	0.41+	0.59+	0.55	0.54
112	0.53	0.20	0.16	1.35+	0.16	1.08+	0.22	0.27	0.18	0.28	0.18	0.28
113	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
115	0.31	0.35	0.25	0.33	0.27	0.33	0.26	0.39	0.25	0.32	0.28	0.38
116	0.27	0.45	0.25	0.43	0.27	0.35	0.21	0.42	0.36	0.49	0.37	0.49
117	0.07	0.12	0.19	0.25	0.17	0.19	0.16	0.29	0.26	0.38	0.10	0.30
119	0.28	0.30	0.15	0.19	0.23	0.28	0.29	0.36	0.21	0.28	0.17	0.28
122	0.20	0.30	0.07	0.20	0.10	0.06	0.20	0.30	0.30	0.02+	0.40	0.30
123	0.24	0.31	0.18	0.23	0.39	0.48	0.25	0.30	0.21	0.24	0.23	0.28
124	0.15	0.23	0.06	0.20	0.23	+	0.17	0.15	0.09	0.20	0.14	0.18
125	0.50	0.20	0.30	0.20	0.30	0.30	0.20	0.20	0.30	0.30	0.20	0.30

APPENDIX C (Continued)

TABLE C-7. RAW DATA FOR FLUORANTHENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	4.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00
LAB NUMBER												
101	0.35+	0.06+	0.38+	0.19+	0.33+	0.16+	0.43+	0.22+	0.22+	0.24+	0.09+	0.16+
102	3.38	2.12	3.42	1.49	3.27	2.45	3.53	2.60	3.71	2.41	3.32	2.23
103	2.40	1.10	3.60	4.00	1.20	0.30	4.20	3.60	3.80	2.00	2.60	2.80
104	0.92+	0.70+	0.70+	0.75+	1.10	0.84	1.40	0.71	1.30	0.41	1.10+	1.00
108	2.08	2.51	4.11+	3.31+	6.58+	5.76+	4.92	3.51	3.53	1.28	2.83	1.07
110	7.90+	6.20+	4.68+	28.00+	4.30+	4.96+	14.40+	6.20+	10.00+	6.44+	6.76+	0.78
112	2.07	1.55	2.58	2.10	2.08	1.42	1.36	1.26	2.19	1.77	2.67	0.87
113	1.40+	0.00+	2.60	1.80	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
115	4.20	3.30	3.70	2.80	4.00	2.80	3.20	2.90	3.60	3.00	3.50	2.70
116	2.65	2.58	1.93	2.03	3.41	2.73	2.99	2.57	3.33	1.24	3.88	2.76
117	1.46	0.71	2.86	2.23	1.93	1.87	1.94	1.22	3.16	2.27	2.50	1.44
119	3.66	2.37	3.35	2.68	3.08	2.32	3.05	2.59	3.30	2.17	2.75	2.14
122	1.60	1.20	3.60	0.50	2.80	1.10	1.80	7.00+	1.80	1.80	3.00	1.00
123	2.92	1.64	1.13	1.43	2.50	2.28	2.87	2.54	2.88	1.67	3.13	2.72
124	3.00	0.98	2.30	1.90	2.50	1.70	2.70	1.90	2.90	2.00	2.70	2.40
125	2.30	2.40	2.60	2.10	2.80	2.00	2.70	2.30	2.50	2.00	2.40	2.20

APPENDIX C (Continued)

TABLE C-7. RAW DATA FOR FLUORANTHENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00
LAB NUMBER												
101	0.37+	0.28+	0.95+	1.20+	1.30+	0.86+	0.93+	0.69+	0.42+	0.46+	0.77+	0.57+
102	8.06	12.10	12.60	12.20	13.20	9.33	11.80	9.17	12.10	8.50	12.20	10.40
103	14.00	9.30	11.00	6.40	5.20	5.50	5.50	8.70	14.00	8.30	12.00	12.00
104	3.00+	2.70+	2.90+	1.70+	3.00	2.60	5.80	4.20	6.60	+	5.80	5.10
108	26.70+	10.50	24.00+	15.50+	16.00+	23.20+	13.90	15.50	7.30	8.72	33.30	7.22
110	35.00+	18.20+	30.00+	49.40+	25.70+	29.00+	23.40+	24.40+	30.90+	25.10+	35.00	25.40+
112	8.98	10.20	4.12	6.52	2.14	7.92	9.64	7.39	10.68	8.05	65.22+	7.31
113	0.00+	0.00+	5.50	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
115	14.70	9.00	13.60	8.90	12.50	10.90	13.60	11.50	14.20	11.10	14.90	11.50
116	14.90	12.30	14.10	12.90	13.40	8.93	15.00	11.30	14.20	13.60	8.10	10.40
117	12.60	6.46	14.40	7.38	4.39	10.10	8.00	9.90	33.70+	9.23	12.90	17.80+
119	13.80	11.50	13.90	11.90	13.60	10.70	14.40	12.50	13.00	9.85	10.50	9.55
122	9.40	3.10	10.10	6.40	8.30	0.90	11.50	10.20	14.60	+	3.50	10.20
123	7.27	65.30+	8.56	75.50+	12.00	82.30+	11.50	83.90+	3.91	74.90+	12.90	90.70+
124	8.80	9.30	11.00	7.70	7.10	5.10	12.00	7.60	11.00	7.80	12.00	7.70
125	7.70	7.30	7.20	6.20	6.30	5.80	7.00	6.00	6.80	5.60	6.50	6.00

APPENDIX C (Continued)

TABLE C-8. RAW DATA FOR PYRENE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	2.00	2.60	2.00	2.60	2.00	2.60	2.00	2.60	2.00	2.60	2.00	2.60
LAB NUMBER												
101	2.10	1.50	2.60	3.30	1.30	1.60	1.60	2.20	1.60	2.20	1.50	1.90
102	1.73	3.12	1.42	2.70	1.90	2.96+	1.37	2.50	1.55	2.89	1.43	2.45
103	1.60	1.20	0.00+	1.80	0.41	3.60+	0.00+	2.40	0.00+	0.00+	0.00+	0.00+
104	0.84	0.90	0.96	0.97	1.40	1.80	1.50	1.80	1.30	1.90	1.20	1.80
108	1.18	0.37	2.80	1.82	1.55	1.56	1.77	1.29	1.84	0.85	1.46	3.17
110	1.40	2.20	2.60+	3.50+	2.20	1.85	3.06+	4.32+	2.66+	3.90+	2.70	2.96
112	1.14	1.06	0.71	0.91	1.11	1.86	1.37	2.11	2.16	2.17	1.16	1.15
113	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
115	1.70	2.10	1.10	1.60	1.70	1.90	1.50	2.20	1.40	2.20	1.60	2.00
116	1.16	2.44	1.19	1.97	1.12	1.29	0.97	1.89	1.69	2.23	2.30	2.60
117	0.40	0.43	1.26	1.42	1.28	1.46	0.79	1.65	1.14	1.54	0.64	1.52
119	1.60	1.53	0.96	1.38	1.50	1.80	1.03	2.63	1.38	1.90	1.23	1.86
122	< 0.80+	1.40	< 0.80+	< 0.80+	< 0.80+	< 0.80+	< 0.80+	< 0.80+	1.60	< 0.80+	< 0.80+	< 0.80+
123	11.70+	13.90+	11.00+	16.30+	12.20+	15.90+	17.10+	15.70+	13.40+	15.70+	15.30+	20.10+
124	1.10	1.90	1.10	1.40	2.00	1.70	1.30	1.20	1.40	1.40	1.70	1.50
125	1.60	1.20	1.80	3.00	2.20	1.70	1.90	2.00	1.60	2.60	1.40	1.80

APPENDIX C (Continued)

TABLE C-8. RAW DATA FOR PYRENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-98)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	24.00	28.00	24.00	28.00	24.00	28.00	24.00	28.00	24.00	28.00	24.00	28.00
LAB NUMBER												
101	22.00	29.00	26.00	28.00	18.00	21.00	20.00	24.00	13.00	19.00	13.00	20.00
102	22.10	21.40	22.00	14.50	20.40	23.90	23.80	25.20	23.40	21.80	20.90	20.40
103	13.00	11.00	24.00	51.00*	26.00	37.00	20.00	32.00	0.71	23.00	0.37*	28.00
104	11.00	12.00	8.90	15.00	12.00	15.00	16.00	13.00	15.00	7.90	12.00	18.00
108	8.89	10.20	12.30	11.40	19.50	22.80	16.00	15.80	7.75	14.00	21.00	22.80
110	26.60	25.20	18.40*	30.80*	14.00	31.20	43.00*	31.80*	26.00*	30.00*	26.60	10.60
112	13.21	14.49	13.88	17.73	59.60*	14.19	9.51	11.91	11.53	14.10	11.43	9.11
113	9.20	20.00	17.00	22.00	5.30*	13.00*	0.00*	15.00*	0.00*	0.00*	0.00*	5.80*
115	23.40	28.20	21.40	24.70	23.50	25.50	19.20	25.70	19.80	25.10	20.70	23.90
116	14.00	21.80	10.30	16.50	13.90	19.30	14.70	17.80	15.20	9.86	17.00	18.60
117	3.86	4.95	15.80	20.10	12.40	17.50	8.32	8.74	12.00	14.90	13.60	10.30
119	22.70	17.90	19.50	23.70	20.10	22.00	29.60	22.30	21.10	18.10	18.90	22.60
122	7.20	6.40	16.50	3.50	12.10*	8.60*	7.70*	34.60*	6.10	7.60	8.70*	2.00*
123	1.62	12.00	5.44	9.07	11.50	15.20	15.80	20.40	15.00	11.80	18.40	22.40
124	18.00	14.00	15.00	26.00	17.00	19.00	19.00	19.00	21.00	19.00	19.00	24.00
125	14.60	20.80	17.60	21.90	20.70	20.40	20.40	20.90	18.80	24.50	19.30	24.00

APPENDIX C (Continued)

TABLE C-8. RAW DATA FOR PYRENE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	90.00	75.00	90.00	75.00	90.00	75.00	90.00	75.00	90.00	75.00	90.00	75.00
LAB NUMBER												
101	82.00	77.00	79.00	88.00	75.00	63.00	72.00	66.00	38.00	39.00	53.00	52.00
102	52.00	81.70	77.10	82.90	88.40	58.50	77.20	55.20	80.30	50.30	82.30	64.40
103	110.00	66.00	116.00	50.00	89.00	74.00	28.00	53.00	270.00*	42.00	240.00*	44.00
104	32.00	33.00	38.00	22.00	34.00	32.00	66.00	51.00	75.00	*	68.00	62.00
108	71.30	48.60	49.20	38.70	34.40	73.20	41.10	41.20	90.60	47.00	70.40	42.50
110	136.00	57.60	85.40*	150.00*	103.00	115.00*	90.60*	96.40*	121.00*	116.00*	142.00*	102.00
112	59.58	58.00	33.59	242.93*	12.66	49.00	68.14	53.00	53.64	40.90	62.85	57.80
113	0.00*	34.00	51.00	4.40	24.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
115	87.10	56.90	76.00	54.00	82.60	65.00	75.60	84.30*	77.70	62.80	93.10	68.30
116	75.90	69.80	49.20	56.90	73.90	58.00	58.30	41.40	60.30	63.40	43.10	48.30
117	65.00	41.00	80.30	43.10	35.90	64.40	34.50	50.20	73.90	65.10	60.90	87.10
119	77.80	67.20	79.20	71.00	82.80	68.30	78.60	60.90	84.40	60.90	71.40	71.40
122	38.20	14.70	44.50	26.70	35.40*	3.90*	51.90*	51.90*	48.30	*	8.20*	25.80*
123	36.70	46.70	39.30	32.90	64.10	45.60	61.60	47.60	21.30	38.20	71.40	56.30
124	65.00	64.00	83.00	61.00	50.00	34.00	81.00	58.00	96.00	60.00	96.00	61.00
125	88.50	65.60	82.30	55.60	77.80	57.80	71.40	55.50	82.90	61.50	75.30	67.60

APPENDIX C (Continued)

TABLE C-9. RAW DATA FOR BENZO(A)ANTHRACENE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.50	0.60	0.50	0.60	0.50	0.60	0.50	0.60	0.50	0.60	0.50	0.60
LAB NUMBER												
101	0.26	0.36	0.59	0.64	0.27	0.35	0.40	0.53	0.27	0.38	0.36	0.43
102	0.39	0.53	0.31	0.47	0.36	0.30	0.35	0.47	0.35	0.48	0.29	0.44
103	0.00+	0.00+	0.87	0.32	0.00+	0.00+	1.20	0.00+	0.00+	0.00+	0.00+	0.00+
104	0.13+	0.16+	0.13+	0.15+	0.28+	0.34+	0.28	0.35	0.27	0.37	0.26	0.35
108	0.75	0.13	0.81	0.60	1.06+	0.43	0.83	0.31	0.19	0.42	1.57+	0.27
110	0.70+	0.46+	0.76+	0.72+	0.62+	0.68+	0.60+	1.00+	0.70+	0.82+	1.00+	0.74+
112	0.55	0.70	1.11	0.13	0.26	1.63+	0.53	0.60	0.58	0.76	0.77	0.51
113	0.22	0.37	0.29	0.40	0.31	0.42	0.32	0.39	0.45	0.32	0.32	0.39
115	0.64	0.81	0.56	0.66	0.58	0.67+	0.58	0.81	0.52	0.79	0.61	0.73
116	0.43	0.71	0.47	0.62	0.38	0.47	0.33	0.65	0.55	0.73	0.64	0.79
117	0.06+	0.08+	0.13	0.17	0.22+	0.22+	0.15+	0.29+	0.26	0.32	0.13	0.24
119	0.39	0.48	0.29	0.34	0.32	0.38	0.34	0.44	0.34	0.39	0.34	0.42
122	1.40+	2.60+	0.80+	1.00+	0.90+	0.80+	1.10	1.40+	2.30+	1.20+	2.50+	2.00+
123	0.32	0.39	0.32	0.34	0.30	0.41	0.60	0.44	0.31	0.35	0.35	0.41
124	0.33	0.55	0.20	0.43	0.59	0.45	0.35	0.30	0.29	0.41	0.31	0.40
125	0.40	0.30	0.40	0.40	0.40	0.40	0.40	0.30	0.40	0.40	0.30	0.40

APPENDIX C (Continued)

TABLE C-9. RAW DATA FOR BENZO(A)ANTHRACENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00
LAB NUMBER												
101	2.20	4.00	6.00	5.30	4.70	3.70	5.30	4.20	2.80	3.50	3.20	3.40
102	5.25	3.60	5.27	2.72	4.71	3.88	5.59	4.10	5.48	3.93	5.13	3.77
103	2.60	1.40	5.50	6.50	4.40	4.80	3.20	5.80	0.00+	4.50	0.00+	5.70
104	1.40+	1.60+	1.60+	1.60+	2.50+	2.20+	2.80	2.00	3.10	0.70	2.70	2.90
108	4.33	4.29	5.21	0.36	6.93	6.25	2.98	6.00	1.06	1.86	6.46	6.19
110	16.00+	10.40+	11.60+	9.60+	10.20+	11.20+	12.40+	11.20+	13.80+	8.80+	12.20+	6.40+
112	4.36	3.55	6.35	5.87	3.83	3.35	1.44	3.00	4.05	3.74	5.49	2.02
113	3.20	4.80	4.70	4.70	3.40	3.50	4.70	4.60	4.20	3.20	5.20	2.20
115	8.80+	7.50+	8.30	6.90	9.00+	6.80	6.50	7.10	7.80	7.10+	7.50	6.60
116	3.40	3.86	2.19	2.63	4.70	3.69	3.31	4.03	4.78	1.55	5.66	4.31
117	1.03+	0.63+	2.84	2.10	2.42+	2.53+	2.39+	1.57+	1.80	2.80	2.55	1.80
119	4.89	4.22	4.59	4.23	4.51	3.61	6.25	5.46	4.61	3.08	4.37	3.97
122	13.90+	8.20+	21.80+	4.90+	18.80+	9.40+	13.60+	36.30+	27.80+	15.60+	21.00+	7.30+
123	4.27	2.10	1.28	1.85	3.09	3.16	4.31	4.04	4.34	2.11	4.98	4.39
124	5.00	3.50	4.50	4.70	5.20	4.00	5.00	3.80	5.00	4.00	5.50	4.40
125	3.20	2.70	2.60	2.60	2.70	2.60	2.60	2.40	2.60	2.30	2.50	2.40

APPENDIX C (Continued)

TABLE C-9. RAW DATA FOR BENZO(A)ANTHRACENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	12.00	16.00	12.00	16.00	12.00	16.00	12.00	16.00	12.00	16.00	12.00	16.00
LAB NUMBER												
101	7.30	12.00	10.00	18.00	10.00	14.00	8.60	12.00	4.40	6.60	6.40	11.00
102	6.37	15.30	9.62	15.60	10.80	11.60	9.68	11.70	10.00	11.20	10.20	13.20
103	12.00	12.00	10.00	6.90	6.60	9.50	2.70	11.00	7.30	5.60	7.80	6.60
104	2.30+	3.20+	2.90+	3.20+	3.70+	4.80+	7.40	8.90	8.90	+	7.60	11.00
108	22.10	12.10	13.40	10.10	11.60	31.90+	4.92	17.80	9.75	8.33	10.30	13.30
110	30.80+	25.40+	25.00+	32.40+	28.40+	31.50+	23.20+	33.00+	25.40+	30.80+	27.20+	37.00+
112	6.97	14.90	7.83	9.88	3.35	14.10	9.05	11.90	11.54	14.10	8.72	12.30
113	4.10	11.90	7.30	14.00	9.00	7.60	8.50	13.80	7.10	13.80	7.10	10.90
115	17.10	18.30	15.60	17.30	16.30	22.00	14.70	25.20+	16.50	21.50	18.00	22.40+
116	12.70	15.80	10.20	13.70	10.40	8.52	10.30	12.50	11.70	16.90	5.56	11.40
117	9.16+	5.92+	9.15	7.22	3.63+	10.30+	5.28+	7.07+	19.10	10.90	8.19	14.90
119	9.36	12.20	11.30	15.10	10.90	13.30	11.30	14.90	11.30	12.80	10.00	12.60
122	30.40+	24.30+	39.50+	35.40+	32.80+	10.50+	46.10+	56.40+	58.50+	+	14.30+	61.40+
123	7.94	6.22	6.91	7.83	10.40	11.40	9.66	10.80	2.30	8.21	10.80	10.50
124	5.90	11.00	12.00	11.00	7.30	7.20	9.20	11.00	13.00	12.00	15.00	13.00
125	6.50	6.90	8.10	6.00	6.40	5.00	5.30	6.10	5.40	5.30	5.10	7.50

APPENDIX C (Continued)

TABLE C-10. RAW DATA FOR CHYRSENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00
LAB NUMBER												
101	1.00	1.70	3.30*	4.20*	1.30	1.90	1.80	3.20	1.70	2.70	1.70	2.50
102	1.53	3.19	1.22	2.70	2.06	3.07	1.74	2.87	1.59	2.95	1.41	2.51
103	0.00*	0.00*	0.00*	0.48	0.00*	6.90*	0.00*	0.00*	1.10	5.90	3.00	5.20
104	0.37*	0.51*	0.36*	0.52*	0.83*	1.10*	0.72*	1.20*	0.73*	1.30*	0.89*	1.20*
108	3.60*	5.14	3.16	2.71	18.20*	23.70*	21.80*	18.80*	54.40*	50.70*	52.80*	40.40*
110	1.40	1.52	1.80	2.66	1.46	2.31	2.66	3.84	1.46	2.86	2.88	2.34
112	1.04	1.19	1.71	2.88	4.00	3.87	0.86	1.87	0.56	2.91	1.97	0.88
113	2.70*	4.40*	2.70*	4.80*	3.10*	5.70*	2.80*	4.00*	4.20	2.90	3.70	4.80
115	2.30	3.60	1.90	2.80	2.40	3.00	2.20	3.40	2.00	3.50	2.30	3.10
116	3.04*	5.65*	3.15	4.86	2.78	4.49	2.03	5.02	4.14	5.34	3.99	5.55
117	0.66	0.91	0.82	1.26	0.88	1.20	1.01	1.72	1.16	2.19	0.57	2.34
119	1.82	2.56	1.25	1.51	1.54	2.28	1.46	3.70	1.50	2.11	1.08	1.72
122	1.00	2.20	0.70	1.10	< 0.70*	< 0.70*	0.80	1.30	2.00	1.10	1.30	1.50
123	1.01	1.56	1.06	1.78	1.45	2.13	1.18	1.88	1.04*	1.44*	1.23	1.85
124	1.10	2.10	1.20	1.90	1.30	1.90	1.50	1.50	1.70	1.80	1.30	1.80
125	1.70	1.50	1.60	2.10	2.80	2.30	4.30*	4.50	1.50	3.50	2.00	2.70

APPENDIX C (Continued)

TABLE C-10. RAW DATA FOR CHYRSENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	20.00	28.00	20.00	28.00	20.00	28.00	20.00	28.00	20.00	28.00	20.00	28.00
LAB NUMBER												
101	18.00	30.00	22.00*	35.00*	17.00	22.00	21.00	25.00	15.00	25.00	13.00	23.00
102	20.60	21.90	20.00	18.90	18.00	26.30	26.90	28.10	20.70	24.60	19.70	23.70
103	0.00*	0.00*	55.00*	96.00*	0.47	94.00*	69.00*	103.00*	39.00	100.00*	0.00*	110.00*
104	3.90*	5.20*	3.60*	4.70*	7.30*	10.00*	7.50*	7.00*	7.10*	2.40*	6.50*	12.00*
108	4.38	2.98	3.33	2.21	17.30	11.80	27.00	19.90	57.00	64.00	52.00	46.00
110	34.00	39.40	29.00	40.60	24.40	37.40	28.40	55.40*	47.40	47.80	40.00	33.60
112	8.99	9.88	17.00	23.35	12.69	15.27	6.45	11.78	12.77	18.42	15.88	8.75
113	27.00*	60.00*	38.00*	55.00*	30.00*	47.00*	38.00*	53.00*	34.00	44.00	36.00	28.00
115	24.30	33.20	23.00	32.50	24.20	31.10	15.60	30.70	20.20	31.10	18.30	29.50
116	16.30*	26.30*	10.20	19.30	22.40	28.10	15.70	35.00	24.90	12.80	26.10	39.20
117	7.79	6.00	11.10	16.40	8.75	15.20	8.36	8.84	12.80	15.60	9.65	11.10
119	14.10	23.50	17.80	25.70	19.20	21.60	15.60	31.70	18.30	25.50	17.70	22.60
122	10.30	13.60	18.30	6.10	16.70	13.10	11.40	43.50*	22.80	19.80	16.10	7.00
123	12.40	13.80	3.61	9.82	9.89	16.20	13.60	21.40	11.80*	14.10*	15.10	22.40
124	15.00	18.00	13.00	21.00	13.00	13.00	14.00	19.00	15.00	21.00	15.00	22.00
125	10.20	21.80	15.20	20.60	12.00	22.50	15.80	27.10	25.80	30.30	22.60	32.70

APPENDIX C (Continued)

TABLE C-10. RAW DATA FOR CHYRSENE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	60.00	40.00	60.00	40.00	60.00	40.00	60.00	40.00	60.00	40.00	60.00	40.00
LAB NUMBER												
101	58.00	44.00	84.00*	150.00*	53.00	37.00	51.00	37.00	34.00	27.00	40.00	33.00
102	38.20	53.10	56.90	60.40	70.20	34.80	58.90	37.90	59.20	28.80	57.20	40.60
103	75.00	53.00	120.00	3.70	110.00	9.60	96.00	89.00	130.00	96.00	111.00	100.00*
104	6.30*	3.50*	10.00*	5.30*	12.00*	7.90*	25.00*	16.00*	33.00*	*	28.00*	22.00*
108	2.54	1.73	4.16	4.49	7.80	13.50	24.50	23.20	46.60	48.50	41.60	36.60
110	95.60	44.40	105.00	55.20	87.40	74.40	92.40	72.00	119.00	74.00	114.00	80.50
112	26.38	31.76	21.58	25.80	10.55	29.80	36.13	25.70	49.69	29.10	34.99	25.90
113	68.00*	63.00*	85.00*	70.00*	106.00*	79.00*	100.00*	57.00*	76.00	73.00	91.00	67.00
115	70.80	35.20	65.60	33.30	72.70	43.90	61.80	50.50	67.30	43.10	76.50	45.90
116	82.80*	55.30*	76.40	59.50	64.60	30.40	72.30	54.60	68.60	68.80	38.00	39.90
117	36.60	17.00	49.80	20.00	19.60	28.60	26.80	30.10	151.00	28.30	45.60	38.90
119	61.40	44.80	77.50	55.00	64.20	42.40	69.70	65.50	69.40	47.20	57.90	48.60
122	79.60	15.10	81.00	29.10	39.00	7.10	52.20	111.00	69.30	*	13.50	45.80
123	21.70	31.80	32.70	23.50	43.00	26.20	42.40	24.30	9.15*	23.50*	48.90	32.20
124	17.00	21.00	41.00	25.00	23.00	12.00	39.00	25.00	42.00	25.00	54.00	27.00
125	42.50	24.90	49.50	26.00	36.10	54.90	61.30	25.20	73.50	40.20	63.90	27.90

APPENDIX C (Continued)

TABLE C-11. RAW DATA FOR BENZO(B)FLUORANTHENE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30
LAB NUMBER												
101	1.30+	0.21	0.18	0.25	0.10	0.14	0.14	0.21	0.14+	0.17+	0.12+	0.17+
102	0.55+	0.73+	0.48+	0.69+	0.72+	0.72+	0.47+	0.83+	0.49+	0.68+	0.38+	0.62+
103	0.00+	0.00+	0.00+	0.25	0.00+	0.00+	0.00+	0.22	0.00+	0.00+	0.13	0.16
104	0.06+	0.07+	0.06+	0.07+	0.12	0.16	0.14	0.19	0.12	0.18	0.12	0.17
108	0.07+	0.09+	0.05+	0.08+	0.67+	0.66+	0.39+	0.51+	1.86+	1.14+	2.08+	2.76+
110	0.26	0.16	0.26	0.29	0.20	0.17	0.06	0.22	0.24	0.31	0.28	0.24
112	0.06	0.15	0.10	0.24	0.20	0.27	0.21	0.27	0.16	0.28	0.20	0.28
113	0.11	0.22	0.13	0.22	0.15	0.22	0.17	0.21	0.12	0.11	0.13	0.24
115	0.25	0.33	0.26	0.28	0.24	0.28	0.22	0.33	0.20	0.35	0.26	0.30
116	0.17	0.31	0.21	0.29	0.16	0.20	0.15	0.31	0.27	0.32	0.27	3.83+
117	0.06	0.85+	0.11	0.15	0.10	0.10	0.13	0.18	0.14	0.24	0.08	0.20
119	0.16	0.21	0.18	0.22	0.20	0.25	0.16	0.23	0.18	0.23	0.20	0.25
122	0.20	0.40	0.20	0.20	0.10	0.10	0.10	0.20	0.30	0.20	0.40	0.30
123	0.17	0.22	0.21	0.17	0.18	0.27	0.15	0.25	0.27	0.17	0.19	0.23
124	0.19	0.31	0.10	0.29	0.16	0.20	0.16	0.15	0.15	0.19	0.14	0.19
125	0.20	0.20	0.20	0.20	0.30	0.20	0.20	0.20	0.20	0.30	0.20	0.20

APPENDIX C (Continued)

TABLE C-11. RAW DATA FOR BENZO(B)FLUORANTHENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00
LAB NUMBER												
101	1.90	0.70	2.10	1.30	1.70	1.20	2.08	1.40	1.00*	1.20*	1.20*	1.20*
102	7.11*	4.62*	7.17*	3.71*	6.76*	5.12*	7.52*	5.29*	7.48*	5.10*	7.17*	4.93*
103	2.10	0.85	3.90	5.80*	4.40	4.10*	3.80	3.10	2.70	2.60	1.60	3.00
104	0.81*	0.66*	0.72*	0.57*	1.40	1.00	1.80	0.86	1.60	0.23	1.40	1.30
108	0.13*	0.05*	0.17*	0.18*	0.92	0.47	0.84	0.49	1.96	1.84	3.66	2.75
110	3.64	2.12	3.16	2.24	2.42	2.08	2.69	2.47	4.44*	2.68	3.95	2.16
112	13.20*	1.60	3.13	2.63	1.96	1.17	1.44	13.06*	2.43	2.02	2.76	0.97
113	1.90	2.00	2.20	2.00	2.10	1.70	2.20	2.00	1.90	0.46	2.40	1.00
115	3.50	2.60	3.20	2.60	3.70	2.10	1.90	2.20	2.80	2.30	2.50	2.30
116	1.81	1.59	1.06	1.16	2.27	1.57	1.50	2.03	2.68	0.71	3.18	2.25
117	1.21	0.48	1.86	1.20	1.20	1.09	1.34	0.75	2.20	1.46	1.29	0.79
119	2.12	1.86	2.32	1.90	2.47	1.81	2.28	2.50	2.52	2.25	2.75	2.19
122	1.70	0.90	3.00	0.60	2.70	1.50	1.80	5.50*	3.50	2.10	2.90	0.90
123	2.66	1.37	0.54	1.04	2.12	2.05	2.63	2.08	2.40	1.44	2.87	2.35
124	2.60	1.40	2.40	1.20	2.00	1.30	2.40	1.70	2.60	1.70	2.80	2.00
125	1.80	1.80	2.40	1.80	2.00	1.60	2.00	2.00	2.10	1.80	2.00	1.80

APPENDIX C (Continued)

TABLE C-11. RAW DATA FOR BENZO(B)FLUORANTHENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	8.00	11.00	8.00	11.00	8.00	11.00	8.00	11.00	8.00	11.00	8.00	11.00
LAB NUMBER												
101	2.60	3.00	4.60	8.70	5.50	6.80	4.70	6.60	2.70+	4.00+	3.70+	6.60+
102	13.70+	26.50+	20.50+	26.80+	19.70+	21.60+	17.40+	21.20+	18.00+	20.30+	18.10+	23.30+
103	12.00	14.00	15.00+	12.00	9.90	16.00	3.60	12.00	12.00	11.00	9.90	16.00
104	1.50+	2.00+	1.90+	2.20+	2.60	3.20	5.20	6.30	6.60	+	5.60	6.30
108	0.02+	0.08+	0.10+	0.06+	0.67	0.31	0.48	0.39	1.13	1.09	2.11	2.55
110	10.70	9.20	8.78	11.70	10.40	17.70	7.31	15.50	12.80	18.10	13.20	17.60
112	5.52	12.92	3.64	10.05	1.57	11.07	7.31	9.51	9.50	11.97	7.69	10.80
113	5.70	9.00	3.80	9.50	7.40	10.70	7.00	10.50	5.60	9.40	7.20	10.20
115	10.70	10.10	9.10	9.60	9.00	11.90	7.90	13.10	9.80	12.60	10.00	12.30
116	9.86	11.23	9.29	12.51	7.77	6.04	8.57	11.00	9.12	14.40	4.08	8.61
117	4.75	4.60	7.30	5.88	2.50	7.88	4.32	8.11	18.60	7.80	6.29	12.00
119	6.97	9.07	8.23	12.40	8.73	11.10	9.45	12.60	9.95	11.30	7.82	10.20
122	6.10	5.50	8.60	7.20	6.20	2.30	8.00	13.11	12.50	+	2.90	13.30
123	7.54	5.75	6.80	8.10	8.76	10.40	8.37	7.29	1.40	7.29	9.51	10.70
124	4.30	6.90	7.40	8.70	4.00	4.10	6.70	8.10	8.00	8.80	9.70	8.60
125	6.10	6.10	6.40	6.80	4.70	5.00	5.20	5.40	5.10	5.50	4.90	5.70

APPENDIX C (Continued)

TABLE C-12. RAW DATA FOR BENZO(K)FLUORANTHENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15
LAB NUMBER												
101	0.04	0.08	0.05	0.07	0.03+	0.04+	0.03	0.06	0.03+	0.06+	0.03+	0.05+
102	0.17	0.25	0.15	0.24	0.23	0.25	0.14	0.23+	0.15	0.24	0.12	0.22+
103	0.20	3.10+	0.50+	0.00+	0.00+	0.00+	0.00+	0.00+	4.40+	8.10+	0.00+	0.00+
104	0.03	0.04	0.03+	0.04+	0.06	0.08	0.06	0.09	0.05	0.09	0.06	0.09
108	0.05+	0.06+	0.05	0.09	0.56+	0.77	0.37	0.50+	1.95+	1.01	1.93+	1.37+
110	0.04	0.04	0.04	0.07	0.04	0.06	0.04	0.08	0.06	0.08	0.07	0.07
112	0.02	0.17	0.08	0.99+	0.09	1.04	0.59+	0.14	0.08	0.14	0.09	0.15
113	0.03	0.07	0.04	0.07	0.04	0.07	0.05	0.08	0.03+	0.05+	0.04	0.09
115	0.10	0.13	0.09	0.14	0.07	0.12	0.08	0.14	0.07	0.14	0.08	0.12
116	0.25+	0.53+	0.29+	0.51	0.22	0.33	0.23+	0.53+	0.40+	0.55	0.41+	0.60+
117	0.01	0.02	0.01	0.03	0.03+	0.03+	0.04+	0.06+	0.04	0.08	0.02	0.07
119	0.05	0.08	0.05	0.07	0.07	0.09	0.04	0.09	0.06	0.09	0.06	0.08
122	0.05	0.10	0.04	0.05	0.04	0.04	0.08	0.10	0.10	0.10	0.10	0.10
123	0.70+	1.03+	0.69+	0.83+	0.73+	1.26+	0.49+	1.16+	0.61+	0.74	0.68+	0.98+
124	0.33+	0.45+	0.02	0.55	0.25	0.34	0.28	0.32+	0.29+	0.49	0.25+	0.47+
125	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.10	0.10

APPENDIX C (Continued)

TABLE C-12. RAW DATA FOR BENZO(K)FLUORANTHENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	1.40	1.10	1.40	1.10	1.40	1.10	1.40	1.10	1.40	1.10	1.40	1.10
LAB NUMBER												
101	0.55	0.11	0.65	0.35	0.51+	0.33+	0.62	0.46	0.30+	0.24+	0.37+	0.36+
102	2.47	1.55	2.51	1.30	2.38	1.79	2.74+	1.85+	2.65	1.76	2.52	1.71
103	1.50	0.81	0.25	4.20	4.20	3.30	0.00+	0.80	0.00+	2.50	0.00+	2.10
104	0.40	0.31	0.37+	0.25+	0.68	0.49	0.78	0.42	0.80	0.12	0.75	0.62
108	0.11+	0.09+	0.18	0.07	0.88	0.80	0.71	0.38	2.07	2.54	2.20	2.74
110	1.24	0.66	1.08	0.74	0.95	0.74	1.12	0.84	1.42	0.80	1.22	0.70
112	0.83	0.11	1.38	1.17	1.29	0.90	0.09	0.19	1.41	1.12	1.38	0.48
113	0.58	0.57	0.50	0.60	0.64	0.54	0.78	0.62	0.70+	0.48+	0.80	0.31
115	1.50	0.99	1.30	1.00	1.60	0.98	0.80	0.91	1.20	0.94	1.00	0.89
116	3.21+	2.65+	1.97	2.10	4.13	2.82	2.80+	3.54+	4.74	1.28	5.70+	3.92+
117	0.27	0.12	0.57	0.34	0.39+	0.35+	0.44+	0.25+	0.75	0.50	0.43	0.27
119	0.78	0.57	0.81	0.64	0.87	0.62	0.86	0.90	0.92	0.80	0.97	0.75
122	0.50	0.30	1.00	0.20	0.90	0.50	0.60	1.70+	1.10	0.70	0.90	0.30
123	11.00+	5.46+	2.22+	4.32+	8.99+	7.76+	11.70+	9.27+	10.90+	8.15+	12.10+	9.14+
124	4.00+	2.70+	4.00+	3.80	3.50	2.00	3.70+	2.60+	4.00	2.70	4.50+	3.40
125	1.00	0.80	1.20	1.00	1.30	0.90	1.20	1.00	1.20	1.00	1.30	1.10

APPENDIX C (Continued)

TABLE C-12. RAW DATA FOR BENZO(K)FLUORANTHENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00
LAB NUMBER												
101	0.43	0.53	1.30	2.70	1.60*	2.00*	1.30	2.10	0.70*	1.20*	1.00*	2.10*
102	3.96	10.20	6.33	11.30	7.17	8.68	6.31*	8.55	6.53	7.90	6.45	9.49
103	7.70*	9.30	9.20	7.90	8.20	11.00	23.00*	9.30	1.70	92.00*	11.00	72.00*
104	0.52	0.63	0.86*	1.10*	1.20	1.60	2.40	3.20	3.00	*	2.60	4.20
108	*	0.08*	0.10	0.06	0.49	0.64	0.50	0.37	2.22	2.68	2.11	2.05
110	3.35	3.46	2.75	4.56	3.35	5.78	2.48	5.16	3.96	5.58	3.88	5.34
112	0.44	5.58	0.36	4.81	1.00	5.74	2.75	4.14	0.42	5.96	3.51	5.54
113	1.50	2.90	1.20	3.20	2.10	3.20	1.80	3.20	1.50*	2.80*	1.80	3.10
115	3.10	4.00	3.20	3.90	3.10	5.00	3.10	5.10	3.60	5.10	3.60	5.00
116	14.60*	17.20*	14.90	22.00*	12.00*	11.00	13.70*	19.70*	14.40*	26.00*	6.50*	16.20*
117	2.75	1.38	2.00	1.81	0.73*	2.84*	1.28*	1.38*	6.08	1.32	1.86	4.17
119	1.97	2.93	2.69	4.33	2.73	3.82	2.95	4.22	3.06	3.97	2.41	3.59
122	1.70	1.70	2.50	2.40	1.90	0.80	2.30	4.30	3.50	*	0.80	4.00
123	30.10*	20.70*	26.70*	33.20*	33.50*	42.30*	34.10*	40.10*	5.63	5.03	35.00*	44.70*
124	4.40*	9.90*	11.00	14.00	6.10	6.80	9.80*	12.00	11.00*	12.00	13.00	11.00
125	3.00	3.30	3.20	3.60	2.60	3.00	2.80	3.00	2.90	3.10	2.80	3.30

APPENDIX C (Continued)

TABLE C-13. RAW DATA FOR BENZO(A)PYRENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.30
LAB NUMBER												
101	0.25	0.59*	0.17*	0.30*	0.19	0.24	0.22*	0.38*	0.18	0.36	0.22*	0.34*
102	0.13	0.27	0.05	0.13	0.19	0.25	0.14	0.25	0.13	0.26	0.11	0.24
103	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
104	0.08	0.01	0.09	0.12	0.17	0.24	0.19	0.32	0.18	0.31	0.18	0.29
108	0.13	0.11	0.10	0.10	0.30	0.38	0.26	0.41	1.98*	2.01*	2.20*	2.85*
110	0.10	0.13	0.04	0.14	0.09	0.14	0.09	0.18	0.13	0.23	0.18	0.18
112	0.11	0.25	0.11	0.68*	0.14	0.27	0.16	0.24	0.10	0.02	0.13	0.16
113	0.09	0.17	0.08	0.17	0.11	0.18	0.12	0.22	0.13	0.11	0.13	0.25
115	0.05	0.17	0.06	0.09	0.08	0.18	0.18	0.26	0.09	0.21	0.16	0.23
116	0.17*	0.35*	0.17	0.26	0.19	0.25	0.17	0.37	0.33*	0.40	0.29	0.44*
117	< 0.00*	< 0.00*	0.05	0.07	0.04	0.04	0.08	0.14	0.07	0.12	0.04	0.16
119	0.14	0.21	0.14	0.19	0.19	0.24	0.12	0.14	0.14	0.22	0.15	0.23
122	0.08	0.20	< 0.01*	0.03	0.04	0.08	0.09	0.10	0.20	0.10	0.20	0.20
123	0.11	0.16	0.10	0.16	0.12	0.20	0.10	0.18	0.09	0.13	0.11	0.16
124	0.09	0.25	0.02	0.13	0.14	0.21	0.18	0.15	0.14	0.19	0.14	0.19
125	0.20	0.20	0.20	0.20	0.20	0.10	0.20	0.20	0.20	0.30	0.20	0.20

APPENDIX C (Continued)

TABLE C-13. RAW DATA FOR BENZO(A)PYRENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
LAB NUMBER												
101	2.30	0.98	2.40*	2.80*	2.30	2.80	2.90*	4.00*	1.50	3.40	1.80*	3.30*
102	1.66	2.01	1.63	1.55	1.56	2.29	1.78	2.21	1.82	2.17	1.73	2.04
103	0.00*	0.33	0.00*	5.30*	0.00*	4.00	0.47	4.30	0.00*	1.30*	0.00*	3.30
104	0.84	1.30	0.79	1.20	1.40	1.90	1.70	1.70	1.70	0.50	1.60	2.60
108	0.15	0.13	0.11	0.10	0.41	0.36	0.59	0.21	1.75	1.89	2.50	3.17
110	2.62	2.86	1.16	1.76	1.80	2.42	2.26	2.56	2.06	2.44	1.86	2.02
112	1.00	1.28	1.40	2.28	1.32	1.58	0.57	1.22	1.11	1.80	1.46	1.02
113	1.10	2.30	1.10	1.90	1.30	1.80	1.60	2.20	1.30	1.60	1.40	1.00
115	1.90	2.00	1.10	1.50	1.90	2.20	1.10	2.40	1.30	2.00	1.30	2.20
116	1.32*	2.27*	0.66	1.54	1.73	2.21	1.21	2.63	2.01	1.03	2.26	2.90
117 <	0.00*	0.03*	0.28	0.14	0.59	0.96	0.66	0.67	0.83	1.17	0.68	0.77
119	1.47	2.00	1.41	2.15	1.59	2.11	1.81	2.82	1.56	2.55	1.58	2.28
122	0.70	1.10	1.10	0.40	1.20	0.80	1.00	5.40*	1.60	1.60	1.30	0.60
123	1.27	1.17	0.25	0.80	0.98	1.41	1.23	2.11	1.10	1.17	1.34	2.15
124	1.50	1.70	1.00	1.80	1.40	1.70	1.50	2.00	1.50	1.90	1.70	2.40
125	1.00	2.20	1.50	2.20	1.20	1.80	1.60	2.20	1.60	*	1.40	2.40

APPENDIX C (Continued)

TABLE C-13. RAW DATA FOR BENZO(A)PYRENE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00	12.00	15.00
LAB NUMBER												
101	3.70	4.30	13.00+	24.00+	5.80	17.00	14.00+	18.00+	4.60	11.00	11.00+	18.00+
102	5.51	12.80	9.39	14.00	10.10	11.00	9.02	10.70	9.54	9.69	9.68	12.10
103	14.00	3.30	17.00	11.00	15.00	16.00	2.70	1.30	5.70+	1.00+	0.13	1.30
104	2.90	3.20	4.00	4.40	5.20	6.20	11.00	13.00	15.00	+	12.00	18.00
108	0.16	0.12	0.11	0.09	0.50	0.47	0.59	0.43	1.82	1.19	1.17	1.55
110	11.32	12.50	8.42	12.00	11.84	18.70	9.96	15.50	14.36	16.50	14.50	17.10
112	5.33	12.40	3.64	9.44	2.13	11.90	7.88	9.70	9.92	11.60	8.36	11.20
113	6.20	9.80	4.00	8.90	8.60	11.20	7.60	11.90	6.20	10.70	7.80	11.80
115	9.10	9.30	6.60	7.20	9.40	11.80	8.50	14.50	9.20	11.40	11.10	12.50
116	13.90+	14.50+	11.20	15.00	10.90	8.44	11.50	13.80	12.80	17.30	6.43	10.70
117	3.88+	1.94+	4.61	2.64	2.51	8.43	4.25	8.61	18.20	7.52	6.78	12.00
119	7.61	9.92	10.40	14.20	10.60	13.00	11.00	13.70	12.10	12.90	8.78	10.70
122	5.90	4.50	6.80	5.30	5.50	1.90	7.80	12.00	9.50	+	2.20	9.30
123	5.43	5.09	5.17	5.82	8.11	8.59	8.79	8.84	1.28	28.70+	9.05	10.01
124	3.80	6.60	6.30	8.00	4.70	4.70	8.60	7.50	8.50	9.50	10.00	8.70
125	9.00	9.10	9.70	9.70	6.20	6.70	6.50	6.70	6.20	7.20	7.00	7.80

APPENDIX C (Continued)

TABLE C-14. RAW DATA FOR DIBENZO(A,H)ANTHRACENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70
LAB NUMBER												
101	0.35	0.44	0.50	0.67	0.29	0.33	0.28	0.48	0.33	0.56	0.35	0.53
102	0.46	*	0.38	0.65	0.32	0.37	0.41	*	0.45	*	0.31	*
103	4.00+	3.30+	2.00+	3.30+	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+	1.00	0.00+
104	0.14	0.17	0.11+	0.21+	0.37	0.58	0.45	0.68	0.44	0.68	0.46	0.67
108	0.09+	0.08+	0.06+	0.08+	0.15+	0.15+	0.17+	0.30+	0.41+	0.42+	0.38	0.99
110	1.20+	1.10	1.20	1.66+	1.44+	1.10	1.66+	2.36+	2.20+	2.22+	2.86+	1.84
112	0.16	0.48	0.89	0.39	0.16	0.63	0.23	0.28	0.26	0.45	0.37	0.40
113	0.59+	1.20+	0.79+	1.00+	1.00+	1.50+	1.00+	1.50+	1.40+	0.90+	0.94+	2.00+
115	0.30	0.57	0.37	0.47	0.42	0.45	0.45	0.61	0.42	0.68	0.35	0.59
116	0.29	0.70	0.34	0.72	0.34	0.45	0.33	0.76	0.60	0.81	0.61	0.88
117	0.08	0.19	0.10	0.22	0.19	0.19	0.26	0.39	0.29	1.21	0.13	0.37
119	0.08	0.18	0.25	0.32	0.29	0.37	0.17	0.40	0.23	0.34	0.29	0.36
122	0.30	0.70	0.60	0.60	0.10	0.50	0.20	0.50	0.90+	0.60	1.10	1.50
123	0.30	0.40	0.24	0.36	0.28	1.07	0.28	0.52	0.28	0.31	0.56	0.37
124	0.48	0.48	0.33	0.45	0.24	0.39	0.29	0.23	0.38	0.42	0.33	0.49
125	0.90+	0.40	0.60	0.20	0.50	0.40	0.70+	0.20	0.20	1.20	0.50	0.50

APPENDIX C (Continued)

TABLE C-14. RAW DATA FOR DIBENZO(A,H)ANTHRACENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	6.50	5.00	6.50	5.00	6.50	5.00	6.50	5.00	6.50	5.00	6.50	5.00
LAB NUMBER												
101	2.40	1.60	5.50	4.07	4.60	3.20	5.50	3.90	2.90	3.60	3.30	3.20
102	3.12	2.45	5.65	3.26	5.28	4.05	7.51	4.76	6.70	4.37	6.11	4.25
103	0.00+	0.33	1.00	13.30+	35.00+	8.00	5.00	5.00	0.00+	1.60	0.00+	1.30
104	2.60	1.70	2.30+	1.20+	4.90	3.60	5.00	3.00	5.30	0.61	4.90	4.60
108	0.10+	0.08+	0.08+	0.09+	0.25+	0.15+	0.22+	0.15+	0.74+	0.44+	0.88	0.49
110	2.80	1.36	4.76	3.56	9.00	8.00	9.10	6.20	6.00	6.56	9.80	4.16
112	1.41	1.13	3.48	3.37	3.61	2.64	1.21	1.83	3.41	2.93	3.63	1.39
113	6.00+	9.80+	12.00+	13.00+	14.00+	11.30+	15.00+	13.00+	12.40+	9.70+	15.00+	6.10+
115	3.30	2.40	5.50	4.40	6.20	3.50	2.20	3.50	5.00	3.90	4.20	4.30
116	2.05	1.19	1.39	1.80	3.38	2.35	2.22	3.41	4.25	1.04	5.58	4.03
117	1.22	0.53	3.02	1.68	2.26	1.65	2.51	1.37	5.24	3.37	2.68	1.44
119	1.17	1.58	2.55	2.08	3.48	2.54	3.42	2.81	3.23	3.13	3.79	2.94
122	4.40	3.90	10.20	2.20	8.30	4.40	5.60	20.90+	13.30+	8.10	9.70	3.10
123	2.69	1.85	0.53	1.70	3.74	3.04	4.70	3.76	4.13	2.40	4.52	4.10
124	4.70	3.10	3.50	3.70	3.20	1.80	3.60	2.50	3.70	2.70	4.10	3.10
125	2.00	2.80	4.50	2.70	7.30	2.00	5.80	2.70	5.00	2.70	5.30	3.80

APPENDIX C (Continued)

TABLE C-14. RAW DATA FOR DIBENZO(A,H)ANTHRACENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	24.00	20.00	24.00	20.00	24.00	20.00	24.00	20.00	24.00	20.00	24.00	20.00
LAB NUMBER												
101	9.20	7.80	20.00	21.00	19.00	15.00	17.00	14.00	8.80	8.10	12.00	14.00
102	8.49	14.20	20.80	22.50	24.30	16.30	21.30	16.10	22.70	14.90	22.30	16.10
103	27.00*	13.00	44.00	17.00	31.00	21.00	7.30	17.00	40.00	18.00	10.00	17.00
104	3.10	1.70	6.90*	5.60*	12.00	22.00	23.00	18.00	31.00	*	25.00	24.00
108	*	0.10*	*	0.07*	0.12*	0.17*	0.31*	0.13*	0.67*	0.54*	0.17	0.09
110	15.20	12.00	12.00	18.00	14.40	19.20	16.00	16.20	24.80	21.60	27.60	17.40
112	7.71	12.40	6.99	11.97	3.85	14.30	14.50	11.60	18.96	14.70	15.37	13.90
113	14.00*	21.00*	29.00*	38.00*	56.00*	52.00*	49.00*	50.00*	38.00*	47.00*	51.00*	48.00*
115	14.80	10.50	18.40	13.60	19.00	15.40	13.20	18.40	20.40	16.40	20.00	15.80
116	17.10	9.40	23.80	18.90	13.30	7.12	20.80	16.80	20.00	24.20	7.30	12.90
117	7.27	5.30	16.60	6.01	5.66	11.20	10.80	16.00	72.50*	10.40	16.00	23.40
119	9.27	8.19	12.30	13.10	15.10	12.40	13.30	12.50	16.20	12.00	12.60	11.30
122	13.40	13.20	34.80	18.00	26.50	6.00	30.00	27.90*	56.70*	*	14.30	34.20
123	6.64	9.13	12.22	11.10	2.02	14.30	18.50	11.50	20.60	9.86	21.30	15.80
124	3.70	3.70	15.00	11.00	8.00	5.40	12.00	11.00	17.00	11.00	24.00	12.00
125	12.20	8.90	20.30	15.40	13.10	11.60	17.60	14.60	20.70	16.70	19.80	18.20

APPENDIX C (Continued)

TABLE C-15. RAW DATA FOR BENZO(G,H,I)PERYLENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	1.00	1.40	1.00	1.40	1.00	1.40	1.00	1.40	1.00	1.40	1.00	1.40
LAB NUMBER												
101	2.00	2.20	0.72	0.99	0.52	0.65	0.66	1.00	0.67	1.20	0.74	1.10
102	0.92	1.23	0.72	1.25	0.82	0.97	0.84	1.22	0.81	1.27	0.67	1.20
103	0.00*	0.00*	0.00*	0.87	0.00*	0.00*	0.00*	0.00*	3.30*	0.00*	0.00*	0.00*
104	0.23	0.23	0.28*	0.32*	0.56	0.69	0.53	0.80	0.52	0.82	0.54	0.81
108	0.24*	0.24*	0.73*	0.23*	0.87	0.74	0.40*	0.30*	2.04*	1.50	2.77*	3.27*
110	1.20	1.04	1.50*	1.90*	1.26	0.94	1.05*	2.07*	1.64*	2.06*	1.74*	1.86*
112	1.49*	2.69*	1.48*	2.03*	1.77	3.53*	1.45*	2.29*	1.83*	1.75*	1.92	1.62
113	0.60	1.00	0.57	0.90	0.78	1.20	0.71	1.30	1.20	0.60	0.76	1.30
115	0.70	1.12	0.75	0.91	0.78	0.84	0.82	1.09	0.70	1.28	0.79	1.08
116	0.59	1.27	0.97	1.21	0.52	0.83	0.58	1.28	1.05	1.46	1.09	1.54
117	0.11	0.04	0.26	0.38	0.47	0.46	0.52	0.83	0.68	2.46*	0.24	0.76
119	0.40	0.67	0.62	0.80	0.81	0.90	0.44	1.00	0.57	0.87	0.75	0.95
122	0.30	0.80	0.60	0.70	0.40	0.50	0.50	0.70	1.40	1.10	1.40	1.70
123	0.24	0.34	0.36*	0.22*	0.23	0.39	0.14*	0.44*	0.47*	0.58*	0.23*	0.32*
124	0.41	1.00	0.51	0.93	0.55	0.73	0.66	0.59	0.81	0.94	0.66	0.95
125	1.80	1.20	0.90	0.80	1.90	1.30	1.00	1.00	0.90	1.50	1.20	1.10

APPENDIX C (Continued)

TABLE C-15. RAW DATA FOR BENZO(G,H,I)PERYLENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00	14.00	10.00
LAB NUMBER												
101	4.00	1.50	8.40	5.50	9.50	6.40	11.00	7.70	6.40	7.20	5.00	6.30
102	6.52	5.07	12.70	6.37	12.20	8.30	15.40	9.51	14.20	8.42	13.50	8.25
103	5.40	3.50	17.00	30.00+	13.00	22.00+	15.00	20.00+	0.00+	15.00	0.00+	18.00+
104	3.80	2.40	2.80+	1.60+	5.70	4.10	6.60	3.50	6.70	0.91	6.00	5.50
108	0.23+	0.22+	0.21+	0.27+	1.01	0.77	0.41+	0.32+	2.32	4.19	5.45	3.48
110	10.80	7.00	15.60+	10.40+	13.40	10.20	13.40+	11.30+	19.40+	9.60+	16.40+	8.00+
112	8.97+	6.36+	23.24+	19.76+	21.48	14.33	7.76+	10.51+	19.73+	15.60+	5.49	8.37
113	5.20	8.20	11.00	10.00	11.00	9.20	14.10	11.00	10.20	7.10	12.80	5.00
115	7.60	5.30	11.40	8.40	13.20	7.00	7.80	7.30	10.60	7.70	9.10	7.70
116	4.91	3.51	4.04	4.47	8.18	5.57	5.89	7.54	10.70	2.50	11.90	7.81
117	0.64	0.64	7.64	4.50	6.40	6.00	5.78	2.88	9.69	6.50	5.47	2.91
119	5.54	5.20	6.85	5.03	9.38	6.40	9.50	7.48	8.43	7.64	10.10	7.52
122	4.60	2.90	11.80	2.30	106.00+	5.40	7.10	20.10+	15.20	9.30	12.80	3.90
123	2.55	1.78	0.84+	1.29+	3.15	2.32	4.38+	3.42+	3.74+	2.23+	4.37+	4.26+
124	10.00	7.50	7.50	6.40	7.00	4.00	7.70	5.60	9.60	6.00	6.80	6.50
125	6.60	6.60	11.70	8.80	39.50+	7.00	14.80	8.80	14.20	8.20	13.60	10.10

APPENDIX C (Continued)

TABLE C-15. RAW DATA FOR BENZO(G,H,I)PERYLENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	35.00	50.00	35.00	50.00	35.00	50.00	35.00	50.00	35.00	50.00	35.00	50.00
LAB NUMBER												
101	6.10	8.00	28.00	44.00	29.00	38.00	24.00	35.00	13.00	21.00	18.00	36.00
102	12.30	30.30	30.00	55.20	35.30	41.10	31.20	41.10	32.40	38.10	33.00	45.70
103	54.00	52.00	67.00*	59.00	47.00	83.00	9.80	55.00	8.70	13.00	33.00	17.00
104	3.40	2.80	6.60*	8.60*	9.60	12.00	20.00	26.00	26.00	*	22.00	35.00
108	*	0.24*	*	0.21*	0.91	0.54	0.28*	0.38*	3.43	1.52	2.52	3.11
110	25.80	27.60	39.20*	51.60*	29.40	57.60	34.20*	53.00*	43.20*	63.20*	42.60*	63.00*
112	33.16*	91.30*	29.34*	82.10*	16.12	100.00	98.05*	79.00*	78.62*	103.60*	64.98*	98.50
113	8.00	15.20	19.00	42.00	4.00	54.00	30.00	51.00	24.00	49.00	32.00	51.00
115	21.40	19.60	27.10	31.60	34.70	39.70	23.90	48.30	29.50	40.70	33.50	42.40
116	31.70	28.00	24.90	34.40	29.11	20.60	25.91	34.10	33.80	42.20	14.30	24.00
117	35.30	18.60	21.50	24.10	8.67	43.00	12.70	10.50	62.30	35.00	19.40	65.00
119	16.40	24.90	23.80	40.00	28.10	37.90	24.20	33.60	29.80	35.30	23.30	33.40
122	19.40	19.20	28.30	24.00	22.70	8.60	28.60	60.90	49.70	*	11.30	50.70
123	7.49	6.08	9.07*	11.20*	13.60	15.70	12.80*	12.90*	1.61*	11.60*	15.30*	17.70*
124	6.60	7.50	23.00	27.00	12.00	14.00	19.00	22.00	25.00	30.00	30.00	27.00
125	25.40	24.90	41.00*	48.30	28.40	47.70	34.50	46.50	38.10	49.30	36.50	51.60

APPENDIX C (Continued)

TABLE C-16. RAW DATA FOR INDENO(1,2,3-CD)PYRENE ANALYSIS BY WATER TYPE LOW YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	1	2	1	2	1	2	1	2	1	2	1	2
TRUE CONC:	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00	0.75	1.00
LAB NUMBER												
101	0.33	0.94	0.50	0.68	0.33	0.45	0.35	0.48	0.33*	0.56*	0.33*	0.49*
102	1.54*	2.23*	1.18*	2.06*	1.71*	2.10*	1.37*	1.96*	1.40*	2.14*	1.11*	2.00*
103	1.10*	0.66	0.00*	1.60	0.00*	0.00*	0.00*	0.00*	1.30	0.00*	0.00*	0.00*
104	0.30	0.33	0.29*	0.35*	0.53	0.75	0.62	0.97	0.55	0.92	0.60	0.89
108	0.28*	0.19*	0.13*	0.24*	1.40*	1.22	1.52*	1.34	3.90*	2.75	4.00*	4.58*
110	0.40	0.34	0.40	0.53	0.40	0.24	0.30	0.53	0.35	0.56	0.38	0.33
112	0.27	0.84	0.27	0.98	0.43	0.97	0.41	0.51	0.28	0.51	0.69	0.66
113	0.29	0.58	0.34	0.50	0.32	0.65	0.43	0.76	0.48	0.37	0.41	0.81
115	0.62	0.93	0.65	0.81	0.66	0.94	0.74	1.26	0.71	1.01	0.59	0.90
116	0.54*	1.06*	0.67*	1.20*	0.42	0.73	0.52*	1.20*	1.15*	1.15*	0.96*	1.31*
117	0.15	0.20	0.19	0.34	0.30	0.33	0.42	0.68	0.51	2.05	0.22	0.98
119	0.28	0.47	0.33	0.43	0.31	0.49	0.28	0.56	0.23	0.45	0.38	0.44
122	0.60	1.30	0.70	0.80	0.40	0.60	0.50	0.70	0.90	0.70	1.40*	1.60
123	0.38	0.58	0.31	0.43	0.42	0.75	0.25	0.68	0.34*	0.39*	0.34	0.53
124	0.65	1.30	0.49	1.10	0.51	0.67	0.61	0.60	0.66	1.00	0.57	1.00
125	0.50	0.60	0.60	0.70	0.70	0.80	0.70	0.90	0.80	1.00	0.60	0.70

TABLE C-16. RAW DATA FOR INDENO(1,2,3-CD)PYRENE ANALYSIS BY WATER TYPE MEDIUM YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	3	4	3	4	3	4	3	4	3	4	3	4
TRUE CONC:	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	6.00
LAB NUMBER												
101	2.00	2.50	2.70	3.40	2.40	2.70	2.50	3.10	1.50+	2.70+	1.30+	2.50+
102	9.70+	9.45+	10.30+	6.56+	9.72+	11.90+	11.30+	12.60+	11.10+	12.30+	10.20+	11.70+
103	6.60	0.00+	13.00+	33.00+	0.00+	23.00+	9.80+	18.00+	0.00+	12.00	0.00+	18.00+
104	1.90	2.20	1.60+	1.60+	3.20	3.60	3.40	3.00	3.70	0.67	3.60	4.70
108	0.45+	0.28+	0.50+	0.19+	1.76	1.90	2.46	1.77	5.80	4.46	6.80	4.39
110	3.84	3.54	4.32	4.78	3.44	4.46	3.78	4.76	5.54	5.04	3.23	4.20
112	1.52	1.53	3.02	4.27	2.69	3.05	0.84	2.02	3.00	3.99	3.50	1.72
113	2.50	4.30	2.90	4.30	3.10	3.90	3.60	4.50	2.90	3.40	3.50	2.40
115	4.50	4.60	4.70	6.50	5.40	4.80	3.20	4.80	4.00	5.30	3.40	5.10
116	11.40+	11.60+	6.99+	11.70+	14.60+	15.00+	9.11+	22.40+	22.40+	7.39+	21.20+	25.40+
117	0.97	0.77	2.66	2.55	1.96	2.69	2.27	1.87	4.70	4.51	2.32	2.32
119	1.66	2.67	1.90	2.37	3.08	3.17	2.38	2.79	3.24	4.08	3.16	3.53
122	3.30	4.80	7.10	2.30	6.10	5.10	4.10	19.60+	11.00+	8.80	8.40	3.90
123	2.74	2.28	0.51	1.61	3.00	3.06	3.30	3.94	2.82+	3.00+	3.35	3.82
124	5.50	4.50	4.80	6.60	3.60	3.30	4.50	4.80	5.50	5.10	5.90	6.20
125	2.60	3.60	3.80	4.80	3.60	4.00	3.90	4.60	4.80	5.50	3.90	4.90

APPENDIX C (Continued)

TABLE C-16. RAW DATA FOR INDENO(1,2,3-CD)PYRENE ANALYSIS BY WATER TYPE HIGH YOUDEN PAIR, UG/L

	DISTILLED WATER		TAP WATER		SURFACE WATER		WASTEWATER (C-94)		WASTEWATER (C-95)		WASTEWATER (C-96)	
AMPUL NO:	5	6	5	6	5	6	5	6	5	6	5	6
TRUE CONC:	22.00	15.00	22.00	15.00	22.00	15.00	22.00	15.00	22.00	15.00	22.00	15.00
LAB NUMBER												
101	5.40	7.90	12.00	9.50	12.00	7.70	10.00	7.80	5.40+	4.00+	+	5.50+
102	23.10+	31.90+	42.40+	38.70+	48.20+	27.50+	42.50+	27.30+	44.50+	25.80+	44.10+	31.00+
103	69.00+	40.00+	77.00+	30.00+	54.00+	40.00+	13.00	28.00	48.00	25.00	41.00+	30.00
104	3.40	1.80+	6.10+	4.00+	8.80	5.20	18.00	12.00	23.00	+	19.00	15.00
108	0.10+	0.15+	+	0.25+	0.83	0.76	1.42	1.66	3.77	2.73	3.73	4.22
110	16.00	8.78	16.90	12.10	18.90	17.50	14.10	15.60	25.20	15.60	25.70	15.20
112	7.43	9.62	6.31	8.56	3.25	10.20	11.93	8.03	16.20	10.57	13.70	10.30
113	8.20	7.40	8.30	9.40	15.00	11.80	13.00	11.20	10.10	10.20	13.00	10.70
115	18.10	9.10	18.90	10.40	18.90	12.80	16.60	13.40	20.50	14.10	20.00	13.30
116	80.50+	47.60+	90.70+	71.10+	70.10+	32.10+	90.20+	71.90+	90.10+	95.10+	34.90+	42.20+
117	11.90	5.29	15.60	6.82	5.41	11.10	10.40	9.43	60.60	9.08	16.20	18.10
119	6.83	6.31	11.10	11.10	14.30	10.30	11.20	9.68	15.90	10.30	12.20	8.65
122	21.00	9.70	29.70	13.20	21.40	4.40	27.60	23.70	52.50	+	12.50	34.70
123	6.31	9.33	13.60	10.40	17.30	10.40	15.70	7.27	1.84+	8.68+	14.50	11.10
124	7.20	7.50	20.00	13.00	9.90	5.20	17.00	10.00	22.00	13.00	25.00	12.00
125	14.20	8.30	18.80	10.50	15.10	9.80	18.30	10.20	18.90	10.20	16.80	12.50

APPENDIX D

TABLE D-1. EFFECT OF WATER TYPE ON NAPHTHALENE ANALYSIS

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                         ** POINT ESTIMATES **
DISTILLED WATER SLOPE:GAMMA(1) = 1.04424
WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                -.0261
  3                -.0277                          .0233
  4                 .5510                          .0190
  5                 .7182                         -.0744
  6                 .2681                         -.1148
                                                  -.0208

                      ** ANALYSIS OF VARIANCE **
     SOURCE              DF   SUM OF SQUARES  MEAN SQUARE    F     PROB
REG(DISTILLED)
REG(WATER/DISTILLED)      1     958.47452     958.47452
ERROR                    10       5.69192        .56919     2.18  .0181
                        450     117.61589        .26137

TOTAL
                        461    1081.78234


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **
                   INTERCEPT(WATER-DISTILLED)
          WATER     ESTIMATE       INTERVAL                 SLOPE(WATER-DISTILLED)
                                                       ESTIMATE        INTERVAL
            2
            3       -.0261   (  -.7748 ,     .7226)
            4       -.0277   (  -.7672 ,     .7118)     .0233   (  -.1402 ,     .1868)
            5        .5510   (  -.1764 ,    1.2783)     .0190   (  -.1426 ,     .1805)
            6        .7182   (  -.0447 ,    1.4810)    -.0744   (  -.2327 ,     .0839)
                     .2681   (  -.4651 ,    1.0013)    -.1148   (  -.2825 ,     .0530)
                                                       -.0208   (  -.1799 ,     .1382)
NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER
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APPENDIX D (Continued)

TABLE D-2. EFFECT OF WATER TYPE ON ACENAPHTHYLENE ANALYSIS

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                        ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.12589

WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2              .2960                       -.0485
  3              .4731                       -.0507
  4              .9938                       -.1542
  5              .6611                       -.0971
  6              .5758                       -.0583


                    ** ANALYSIS OF VARIANCE **

    SOURCE               DF   SUM OF SQUARES  MEAN SQUARE    F      PROB

REG(DISTILLED)            1    1057.68341     1057.68341
REG(WATER/DISTILLED)     10       9.22423         .92242    2.75   .0027
ERROR                   459     153.95896         .33542

TOTAL                   470    1220.86660


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

               INTERCEPT(WATER-DISTILLED)              SLOPE(WATER-DISTILLED)
      WATER     ESTIMATE        INTERVAL             ESTIMATE        INTERVAL

        2         .2960  (  -.5323 ,   1.1243)        -.0485  (  -.2254 ,    .1285)
        3         .4731  (  -.3731 ,   1.3194)        -.0507  (  -.2330 ,    .1316)
        4         .9936  (   .1713 ,   1.8159)        -.1542  (  -.3323 ,    .0240)
        5         .6611  (  -.1599 ,   1.4821)        -.0971  (  -.2751 ,    .0808)
        6         .5758  (  -.2529 ,   1.4044)        -.0583  (  -.2374 ,    .1209)

NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER.
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APPENDIX D (Continued)

TABLE D-3. EFFECT OF WATER TYPE ON ACENAPHTHENE ANALYSIS

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                         ** POINT ESTIMATES **
DISTILLED WATER SLOPE:GAMMA(1) = 1.03634
WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)
  2                -.4209
  3                 .1432                        .1022
  4                 .2419                        0022
  5                 .2686                        .0011
  6                 .0921                       -.0281
                                                 0374

                    ** ANALYSIS OF VARIANCE **
    SOURCE                 DF    SUM OF SQUARES  MEAN SQUARE    F      PROB
REG(DISTILLED)              1      709.00189     709.00189
REG(WATER/DISTILLED)       10        5.15317        .51532     1.83   .0545
ERROR                     400      112.90601        .28227

TOTAL                     411      827.06107


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **
                  INTERCEPT(WATER-DISTILLED)
      WATER      ESTIMATE        INTERVAL              SLOPE(WATER-DISTILLED)
                                                       ESTIMATE       INTERVAL
        2         -.4209   ( -1.3330 ,     .4913)
        3          .1432   (  -.7648 ,    1.0510)       .1022   (  -.0981 ,     .3024)
        4          .2419   (  -.6640 ,    1.1478)       .0022   (  -.1987 ,     .2031)
        5          .2686   (  -.6260 ,    1.1633)       .0011   (  -.1972 ,     .1994)
        6          .0921   (  -.8060 ,     .9901)      -.0281   (  -.2264 ,     .1702)
                                                        .0374   (  -.1594 ,     .2342)
```

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

APPENDIX D (Continued)

TABLE D-4. EFFECT OF WATER TYPE ON FLUORENE ANALYSIS

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                          ** POINT ESTIMATES **

        DISTILLED WATER SLOPE:GAMMA(1) =   .95503

        WATER     INTERCEPT(WATER-DISTILLED)    SLOPE(WATER-DISTILLED)

          2                   -.3059                       .0752
          3                    .1989                      -.0350
          4                    .3383                      -.0488
          5                    .0125                      -.0134
          6                    .2853                      -.0461

                        ** ANALYSIS OF VARIANCE **

             SOURCE              DF    SUM OF SQUARES   MEAN SQUARE     F      PROB

        REG(DISTILLED)            1      666.93203       666.93203
        REG(WATER/DISTILLED)     10        2.53991          .25399       .54   .8606
        ERROR                   418      196.08694          .46911

        TOTAL                   429      865.55888


   ** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                    INTERCEPT(WATER-DISTILLED)               SLOPE(WATER-DISTILLED)
        WATER       ESTIMATE        INTERVAL               ESTIMATE        INTERVAL

          2          -.3059   ( -1.3757 ,     .7640)       .0752   (  -.1556 ,     .3059)
          3           .1989   (  -.8848 ,    1.2827)      -.0350   (  -.2682 ,     .1982)
          4           .3383   (  -.7320 ,    1.4085)      -.0488   (  -.2796 ,     .1820)
          5           .0125   ( -1.0975 ,    1.1224)      -.0134   (  -.2558 ,     .2291)
          6           .2853   (  -.8217 ,    1.3924)      -.0461   (  -.2848 ,     .1927)

NOTE:   IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
        DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

        THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
        AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-5. EFFECT OF WATER TYPE ON PHENANTHRENE ANALYSIS

```
                            ** POINT ESTIMATES **
          DISTILLED WATER SLOPE:GAMMA(1) = 1.06818

          WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

            2                -.0057                       .0034
            3                 .3701                      -.0727
            4                 .3079                      -.0315
            5                 .2063                      -.0286
            6                 .2227                      -.0351


                          ** ANALYSIS OF VARIANCE **
              SOURCE             DF   SUM OF SQUARES  MEAN SQUARE    F      PROB

          REG(DISTILLED)          1    1267.27692     1267.27692
          REG(WATER/DISTILLED)   10       2.69159         .26916     2.00   .0320
          ERROR                 467      62.95605         .13481

          TOTAL                 478    1332.92456


  ** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                     INTERCEPT(WATER-DISTILLED)            SLOPE(WATER-DISTILLED)
          WATER      ESTIMATE        INTERVAL            ESTIMATE        INTERVAL

            2         -.0057   (  -.4212 ,    .4097)      .0034   (  -.0980 ,    .1049)
            3          .3701   (  -.0455 ,    .7857)     -.0727   (  -.1739 ,    .0286)
            4          .3079   (  -.1021 ,    .7178)     -.0315   (  -.1327 ,    .0697)
            5          .2063   (  -.2230 ,    .6356)     -.0286   (  -.1347 ,    .0774)
            6          .2227   (  -.1816 ,    .6269)     -.0351   (  -.1341 ,    .0639)

NOTE:   IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
        DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

        THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
        AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-6. EFFECT OF WATER TYPE ON ANTHRACENE ANALYSIS

```
                          ** POINT ESTIMATES **
DISTILLED WATER SLOPE:GAMMA(1) = 1.10903
WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                 .0255
  3                 .6925                        -.0052
  4                 .7203                        -.1295
  5                 .5613                        -.1128
  6                 .7495                        -.1019
                                                 -.1291

                       ** ANALYSIS OF VARIANCE **
      SOURCE                DF   SUM OF SQUARES  MEAN SQUARE   F      PROB
REG(DISTILLED)
REG(WATER/DISTILLED)         1     983.92383     983.92383
ERROR                       10       6.68704        .66870    3.25   .0005
                           439      90.09961        .20524

TOTAL
                           450    1080.89048


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **
          INTERCEPT(WATER-DISTILLED)
WATER      ESTIMATE        INTERVAL                  SLOPE(WATER-DISTILLED)
                                                   ESTIMATE         INTERVAL
  2
  3          .0255   (   -.6230 ,     .6739)
  4          .6925   (    .0333 ,    1.3517)      -.0052   (   -.1497 ,     .1393)
  5          .7203   (    .0761 ,    1.3645)      -.1295   (   -.2761 ,     .0171)
  6          .5613   (   -.0850 ,    1.2077)      -.1128   (   -.2566 ,     .0311)
             .7495   (    .1112 ,    1.3879)      -.1019   (   -.2464 ,     .0426)
                                                  -.1291   (   -.2716 ,     .0134)
```

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

APPENDIX D (Continued)

TABLE D-7. EFFECT OF WATER TYPE ON FLUORANTHENE ANALYSIS

```
                         ** POINT ESTIMATES **
DISTILLED WATER SLOPE:GAMMA(1) =   .96753

WATER     INTERCEPT(WATER-DISTILLED)    SLOPE(WATER-DISTILLED)

  2                 -.1371                      .0763
  3                 -.0872                     -.0470
  4                  .0501                      .0299
  5                  .0255                      .0088
  6                 -.0421                      .0544

                       ** ANALYSIS OF VARIANCE **
       SOURCE               DF    SUM OF SQUARES   MEAN SQUARE     F       PROB

REG(DISTILLED)               1       900.00707      900.00707
REG(WATER/DISTILLED)        10         3.34641         .33464     2.28     .0134
ERROR                      395        58.07798         .14703

TOTAL                      406       961.43145


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **
                INTERCEPT(WATER-DISTILLED)                SLOPE(WATER-DISTILLED)
WATER         ESTIMATE        INTERVAL                 ESTIMATE        INTERVAL

  2            -.1371   (  -.3630 ,     .0889)         .0763   (  -.0502 ,     .2029)
  3            -.0872   (  -.3108 ,     .1364)        -.0470   (  -.1718 ,     .0777)
  4             .0501   (  -.1631 ,     .2632)         .0299   (  -.0899 ,     .1498)
  5             .0255   (  -.1927 ,     .2437)         .0088   (  -.1148 ,     .1324)
  6            -.0421   (  -.2559 ,     .1717)         .0544   (  -.0655 ,     .1742)

NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-8. EFFECT OF WATER TYPE ON PYRENE ANALYSIS

```
                        ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.08892

WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                .2620                     -.0634
  3                .2757                     -.0548
  4                .3354                     -.0696
  5                .3735                     -.1022
  6                .3063                     -.0446


                     ** ANALYSIS OF VARIANCE **

      SOURCE            DF   SUM OF SQUARES  MEAN SQUARE    F      PROB

REG(DISTILLED)           1    1012.98007     1012.98007
REG(WATER/DISTILLED)    10       2.46146         .24615    1.78   .0617
ERROR                  449      62.04649         .13819

TOTAL                  460    1077.48801


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                INTERCEPT(WATER-DISTILLED)              SLOPE(WATER-DISTILLED)
WATER          ESTIMATE       INTERVAL                ESTIMATE       INTERVAL

  2              .2620   (  -.1021 ,      .6262)     -.0634   (  -.1740 ,      .0471)
  3              .2757   (  -.0838 ,      .6351)     -.0548   (  -.1650 ,      .0555)
  4              .3354   (  -.0300 ,      .7007)     -.0696   (  -.1818 ,      .0426)
  5              .3735   (   .0088 ,      .7381)     -.1022   (  -.2141 ,      .0097)
  6              .3063   (  -.0546 ,      .6671)     -.0446   (  -.1555 ,      .0664)

NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-9. EFFECT OF WATER TYPE ON BENZO(A)ANTHRACENE ANALYSIS

```
                              ** POINT ESTIMATES **
          DISTILLED WATER SLOPE:GAMMA(1) =   .98268
          WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

            2                .0001
            3              - .0143                      .0128
            4                .1050                      .0139
            5              - .0244                    - .0335
            6                .0149                    - .0154
                                                        .0294

                          ** ANALYSIS OF VARIANCE **
              SOURCE             DF   SUM OF SQUARES  MEAN SQUARE    F     PROB
          REG(DISTILLED)          1      777.58379     777.58379
          REG(WATER/DISTILLED)   10         .94034        .09403     .72   .7058
          ERROR                 420       54.85436        .13081

          TOTAL                 431      833.37850


  ** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **
          WATER       INTERCEPT(WATER-DISTILLED)              SLOPE(WATER-DISTILLED)
                      ESTIMATE       INTERVAL                 ESTIMATE      INTERVAL

            2           .0001   (  - .2309 ,    .2311)        .0128   (  - .1110 ,    .1366)
            3         - .0143   (  - .2615 ,    .2329)        .0139   (  - .1174 ,    .1453)
            4           .1050   (  - .1277 ,    .3376)      - .0335   (  - .1583 ,    .0913)
            5         - .0244   (  - .2560 ,    .2071)      - .0154   (  - .1388 ,    .1079)
            6           .0149   (  - .2188 ,    .2484)        .0294   (  - .0947 ,    .1535)

NOTE:   IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
        DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

        THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
        AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-10. EFFECT OF WATER TYPE ON CHRYSENE ANALYSIS

```
                            ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) =   .98722

WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                .0168                         .0057
  3                .2407                       -.0586
  4                .0887                         .0653
  5                .0998                         .1046
  6                .1565                         .0454


                      ** ANALYSIS OF VARIANCE **

     SOURCE             DF   SUM OF SQUARES  MEAN SQUARE   F      PROB

REG(DISTILLED)           1     772.59992     772.59992
REG(WATER/DISTILLED)    10      11.04269       1.10427     4.36   .0000
ERROR                  439     111.14149        .25317

TOTAL                  450     894.78410


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                   INTERCEPT(WATER-DISTILLED)          SLOPE(WATER-DISTILLED)
           WATER      ESTIMATE      INTERVAL             ESTIMATE      INTERVAL

             2         .0168   (  -.5237 ,    .5574)    .0057   (  -.1754 ,    .1868)
             3         .2407   (  -.3141 ,    .7954)   -.0586   (  -.2420 ,    .1248)
             4         .0887   (  -.4608 ,    .6383)    .0653   (  -.1172 ,    .2478)
             5         .0998   (  -.4367 ,    .6362)    .1046   (  -.0744 ,    .2836)
             6         .1565   (  -.3704 ,    .6834)    .0454   (  -.1309 ,    .2218)

NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

TABLE D-11. EFFECT OF WATER TYPE ON BENZO(B)FLUORANTHENE ANALYSIS

```
                        ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) =   .99154

WATER     INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                 .0754                          .0116
  3                 .0033                         -.0258
  4                 .0547                          .0103
  5                 .1665                          .0153
  6                 .1821                          .0369


                     ** ANALYSIS OF VARIANCE **

     SOURCE              DF   SUM OF SQUARES  MEAN SQUARE    F      PROB

REG(DISTILLED)            1   1046.46326    1046.46326
REG(WATER/DISTILLED)     10      3.54982        .35498     2.25   .0146
ERROR                   450     71.15432        .15812

TOTAL                   461   1121.16740


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                   INTERCEPT(WATER-DISTILLED)          SLOPE(WATER-DISTILLED)
           WATER    ESTIMATE        INTERVAL            ESTIMATE       INTERVAL

             2       .0754   (  -.1241 ,    .2748)      .0116   (  -.1107 ,    .1338)
             3       .0033   (  -.1934 ,    .2000)     -.0258   (  -.1453 ,    .0937)
             4       .0547   (  -.1415 ,    .2508)      .0103   (  -.1087 ,    .1293)
             5       .1665   (  -.0344 ,    .3674)      .0153   (  -.1075 ,    .1380)
             6       .1821   (  -.0172 ,    .3813)      .0369   (  -.0840 ,    .1578)

NOTE:   IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
        DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

        THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
        AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-12. EFFECT OF WATER TYPE ON BENZO(K)FLUORANTHENE ANALYSIS

```
                        ** POINT ESTIMATES **
DISTILLED WATER SLOPE:GAMMA(1) =  .97311
WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                 .1088
  3                 .3319                    .0259
  4                 .2566                   -.0549
  5                 .4977                   -.0220
  6                 .4208                   -.0460
                                             .0748

                     ** ANALYSIS OF VARIANCE **
       SOURCE               DF    SUM OF SQUARES   MEAN SQUARE     F      PROB

REG(DISTILLED)               1      843.82815      843.82815
REG(WATER/DISTILLED)        10       13.73283        1.37328      3.75   .0001
ERROR                      395      144.54111         .36593

TOTAL                      406     1002.10208


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **
WATER       INTERCEPT(WATER-DISTILLED)              SLOPE(WATER-DISTILLED)
           ESTIMATE        INTERVAL               ESTIMATE        INTERVAL
  2
  3          .1088   (  -.1784 ,    .3939)       .0259   (  -.1640 ,    .2158)
  4          .3319   (   .0397 ,    .6241)      -.0549   (  -.2472 ,    .1375)
  5          .2566   (  -.0426 ,    .5558)      -.0220   (  -.2191 ,    .1751)
  6          .4977   (   .1990 ,    .7965)      -.0460   (  -.2435 ,    .1516)
             .4208   (   .1274 ,    .7142)       .0748   (  -.1234 ,    .2730)
```

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

APPENDIX D (Continued)

TABLE D-13. EFFECT OF WATER TYPE ON BENZO(A)PYRENE ANALYSIS

```
                         ** POINT ESTIMATES **
 DISTILLED WATER SLOPE:GAMMA(1) =   .92122

 WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

   2                -.1848                    .0958
   3                 .2000                    .0339
   4                 .2919                    .0128
   5                 .2210                    .0979
   6                 .2897                    .0320


                      ** ANALYSIS OF VARIANCE **
        SOURCE                DF   SUM OF SQUARES  MEAN SQUARE    F       PROB

 REG(DISTILLED)                1    1247.92405     1247.92405
 REG(WATER/DISTILLED)         10      15.58327        1.55833    4.12    .0000
 ERROR                       484     183.02660         .37815

 TOTAL                       495    1446.53392
```

```
** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                   INTERCEPT(WATER-DISTILLED)            SLOPE(WATER-DISTILLED)
      WATER       ESTIMATE        INTERVAL             ESTIMATE        INTERVAL

        2          -.1848  (  -.4861 ,     .1168)      .0958  (  -.0689 ,    .2606)
        3           .2000  (  -.0912 ,     .4912)      .0339  (  -.1267 ,    .1944)
        4           .2919  (  -.0049 ,     .5888)      .0128  (  -.1502 ,    .1759)
        5           .2210  (  -.0773 ,     .5192)      .0979  (  -.0686 ,    .2645)
        6           .2897  (  -.0125 ,     .5918)      .0320  (  -.1335 ,    .1975)
```

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

APPENDIX D (Continued)

TABLE D-14. EFFECT OF WATER TYPE ON DIBENZO(A,H)ANTHRACENE ANALYSIS

```
                         ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) =  .90229

WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                 .3208                     .0873
  3                 .2894                     .0766
  4                 .2778                     .1259
  5                 .4474                     .0838
  6                 .6825                    -.0412


                       ** ANALYSIS OF VARIANCE **

      SOURCE              DF   SUM OF SQUARES  MEAN SQUARE    F      PROB

REG(DISTILLED)             1     891.53070     891.53070
REG(WATER/DISTILLED)      10      22.23987       2.22399    8.94   .0000
ERROR                    439     109.26783        .24890

TOTAL                    450    1023.03841


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

            INTERCEPT(WATER-DISTILLED)            SLOPE(WATER-DISTILLED)
 WATER      ESTIMATE       INTERVAL              ESTIMATE       INTERVAL

   2          .3208  (  -.0084 ,    .6499)        .0873  (  -.0678 ,    .2424)
   3          .2894  (  -.0328 ,    .6116)        .0766  (  -.0758 ,    .2290)
   4          .2778  (  -.0533 ,    .6089)        .1259  (  -.0297 ,    .2815)
   5          .4474  (   .1159 ,    .7790)        .0838  (  -.0739 ,    .2414)
   6          .6825  (   .3635 ,   1.0014)       -.0412  (  -.1907 ,    .1082)

NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-15. EFFECT OF WATER TYPE ON BENZO(G,H,I)PERYLENE ANALYSIS

```
                          ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) =   .88956

WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2               .0904                         .1558
  3               .3177                         .0313
  4               .2502                         .1104
  5               .5014                         .0319
  6               .3848                         .0728


                       ** ANALYSIS OF VARIANCE **

     SOURCE              DF   SUM OF SQUARES  MEAN SQUARE    F      PROB

REG(DISTILLED)            1      872.64349     872.64349
REG(WATER/DISTILLED)     10       18.76459       1.87646    7.92   .0000
ERROR                   423      100.26381        .23703

TOTAL                   434      991.67189


** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

              INTERCEPT(WATER-DISTILLED)           SLOPE(WATER-DISTILLED)
  WATER      ESTIMATE        INTERVAL             ESTIMATE       INTERVAL

    2          .0904   (  -.3174 ,     .4981)      .1558   (    .0002 ,     .3115)
    3          .3177   (  -.0545 ,     .6898)      .0313   (   -.1097 ,     .1724)
    4          .2502   (  -.1510 ,     .6513)      .1104   (   -.0411 ,     .2618)
    5          .5014   (   .1008 ,     .9020)      .0319   (   -.1199 ,     .1838)
    6          .3848   (  -.0083 ,     .7778)      .0728   (   -.0749 ,     .2205)

NOTE:  IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN
       DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

       THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION
       AND ACCURACY REGRESSIONS PERFORMED EARLIER.
```

APPENDIX D (Continued)

TABLE D-16. EFFECT OF WATER TYPE ON INDENO(1,2,3-CD)PYRENE ANALYSIS

```
                        ** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) =   .95662

WATER    INTERCEPT(WATER-DISTILLED)   SLOPE(WATER-DISTILLED)

  2                .0842                      .0849
  3                .1842                     -.0227
  4                .2239                      .0108
  5                .3636                      .0727
  6                .2579                      .0858


                      ** ANALYSIS OF VARIANCE **

     SOURCE               DF    SUM OF SQUARES   MEAN SQUARE    F      PROB

REG(DISTILLED)             1       668.27649      668.27649
REG(WATER/DISTILLED)      10        10.89425        1.08943    5.98   .0000
ERROR                    407        74.20686         .18233

TOTAL                    418       753.37760
```

```
** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

                INTERCEPT(WATER-DISTILLED)               SLOPE(WATER-DISTILLED)
WATER          ESTIMATE        INTERVAL                ESTIMATE        INTERVAL

  2              .0842  (  -.2268 ,      .3952)       .0849   (  -.0762 ,      .2461)
  3              .1842  (  -.1196 ,      .4880)      -.0227   (  -.1792 ,      .1337)
  4              .2239  (  -.0802 ,      .5280)       .0108   (  -.1449 ,      .1668)
  5              .3636  (   .0487 ,      .6784)       .0727   (  -.0892 ,      .2346)
  6              .2579  (  -.0597 ,      .5755)       .0858   (  -.0759 ,      .2475)
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NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.